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ABSTRACT

This document is a teacher's guide for a unit in tractor and machinery safety for college freshmen. It is intended to be used for 10 hours of instruction for freshmen who are intending to work on or around machinery. Safety hazards directly and indirectly related to many types of machinery are covered in addition to tractors. The objectives of the unit are to help students to develop an understanding of farm accident prevention and the ability to identify types of tractors and machinery and the use of each, to operate a tractor safely, and to perform basic tractor and truck maintenance. The unit is divided into material for four jobs, as follows: (1) identifying types of tractors and machinery; (2) understanding farm accident prevention; (3) operating a tractor safely; and (4) maintaining tractors and trucks. Each of the jobs includes objectives, guide questions, references, an approach to interest students, key facts about the content of the material, and transparency masters. The material can be used to fulfill student requirements for the Tractor Operator's Training Certificate if certain provisions are met. (A student manual coordinated to the unit is available.) (KC)

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TRACTOR SAFETY

Unit A-9

by

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Fargo, North Dakota

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In cooperation with
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TRACTOR SAFETY

Jobs Included

1. Identifying Types of Tractors and Machinery.
2. Understanding Farm Accident Prevention.
3. Operating a Tractor Safely.
4. Maintaining Tractors and Trucks.

Intended Use

This unit is intended as ten hours of instruction for freshmen who are intending to work on or around machinery. Safety hazards directly and indirectly related to many types of machinery are covered in addition to tractors. Safe Operation of Agricultural Equipment - Student Manual, available from the Cooperative Extension Service, is recommended if a student text is to be used. The corresponding chapters are listed at the end of each Job as the sequence is somewhat different.

The students may receive the Tractor Operator's Training Certificate if the following provisions are met:

1. Minimum of 24 hours of instruction.
2. Demonstrate proficiency at operation.
3. Show slide set series, Safe Operation of Agricultural Equipment.
4. Read Safe Operation of Agricultural Equipment - Student Manual and answer review questions at end of each chapter.

Consult your local County Extension agent for more information on certification.

Unit Objectives

1. To develop the ability to identify types of tractors and machinery and the use of each.
2. To develop an understanding of farm accident prevention.
3. To develop the ability to safely operate a tractor.
4. To develop the ability to perform basic tractor and truck maintenance.

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Job 1: Identifying Types of Tractors and Machinery.

Objectives:

The objectives of this job shall be met at a level predetermined by the instructor. The manner in which they are evaluated shall also be determined by the instructor.

Upon completion of this job, the student shall be able:

1. to list types of fuels used in tractors.
2. to identify working accessories on tractors.
3. to identify types of tractors.
4. to identify types of tillage equipment.
5. to identify types of planting equipment.
6. to identify types of chemical applicating equipment.
7. to identify types of hay and forage harvesting equipment.
8. to identify types of grain and row crop harvesting equipment.
9. to identify types of material handling equipment.

Guide Questions:

1. What are some different fuels used to power tractors?
2. What are some accessories used in tractor operation?
3. What are some different types of tractors?
4. What are some different types of tillage equipment?
5. What are some different types of planting equipment?
6. What are some different types of chemical applicating equipment?
7. What are some different types of hay and forage harvesting equipment?
8. What are some different types of grain and row crop harvesting equipment?
9. What are some different types of equipment used in handling materials?

References:

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Interest Approach:

Ask the students to identify the piece of machinery in Transparency Master 1. Give them hints until they have correctly identified it as a cotton picker. Explain that there is a wide variety of machinery being used today, but you will only cover those commonly used in North Dakota.

Key Facts:

I. Tractor Fuels.

A. Diesel - most large tractors.

B. Gasoline - mostly smaller tractors.

C. LP gas - used much near oil fields.

D. Always use fuel tractor is designed for.

II. Tractor Accessories.

A. Power take off (PTO). (Transparency 2)

1. High speed turning shaft used to power machinery.

a. 540 rpm.
b. 1000 rpm.

2. Located at rear of tractor.

B. Hydraulic system. (Transparency 3)

1. Fluid pumped at high pressure through hose.

2. Used mostly to raise and lower equipment.

C. Three point hitch. (Transparency 4)

1. Hitches implement at three points for stability and control.

2. Raises or lowers implement directly from hitch.

D. Weights.

1. Used to increase traction.

2. Located on rear wheels and/or front end.

E. Duals. (Transparency 5)

1. Extra tire added to drive wheels.

2. Reduces compaction in soft ground.

III. Types of Tractors.

A. Two wheel drive.

1. Tricycle type. (Transparency 6)

a. Found on earlier tractors.
b. Allows clearance for row crops.
c. Less stable and less comfortable.

2. Wide front axle. (Transparency 7)

a. Most are adjustable to meet row spacing.
b. Give greater stability and more comfort.

3. High clearance. (Transparency 8)

a. Used for cultivating tall crops.
b. Basically same as wide front axle but less stable.

4. Low profile. (Transparency 9)

a. Used for working in confined areas.

1. Orchards.
2. Feedlots.
3. Buildings.

b. Also similar to wide front axle.
c. Intake and exhaust pipe kept low.

B. Four wheel drive. (Transparency 10)

1. All four wheels same size.

2. Used in larger tractors.

3. Various methods of steering. (Transparency 11)

a. Four-wheel - front and back wheels turn opposite.
b. Crab - front and back wheels turn same.
c. Front-wheel - only front wheels turn.

d. Rear-wheel - only back wheels turn.
e. Articulated - tractor frame is hinged.
f. Important to know what type of steering is being used, and how it affects turning.

4. Front wheel auxiliary drive.

a. Front wheel smaller, but powered.
b. Similar to two wheel drive but greater traction, especially with heavy front end.

C. Crawler. (Transparency 12)

1. Uses a track instead of wheels.

2. Used for heavy pulling.

3. Turns by changing track speeds.

D. Loader. (Transparency 13)

1. May be 2 or 4 wheel drive.

2. Vary in size from very compact to very large.

IV. Types of Tillage Equipment.

A. Types of tillage.

1. Primary - breaking up stubble or sod.

2. Secondary - preparing seedbed and other operations.

3. Cultivation - removing weeds after planting.

B. Moldboard plows - primary tillage. (Transparency 14)

1. Turns soil over, about 13-18 cm (5 to 7 inches) deep.

2. Covers stubble and trash on surface.

C. Disks. (Transparency 15)

1. Concave disks move or turn soil to one side.

2. Types.

a. Disk plow - primary tillage.
b. Disk tiller - primary or secondary tillage.
c. Disk harrow - secondary tillage.

D. Chisel plows and field cultivators. (Transparency 16)

1. Numerous shanks with points to break up soil.

2. Points vary depending on type of tillage desired. (Transparency 17)

3. Chisel plow is heavier and used mostly for primary tillage.

4. Field cultivator used for secondary tillage or cultivation. (Transparency 18)

E. Tooth-type harrows. (Transparency 19)

1. Teeth "scratch" soil surface.

2. Used to smooth, loosen and break up soil.

3. Various kinds of teeth.

F. Other.

1. Stubble-mulch plow - wide sweeps leave trash on surface to prevent erosion. (Transparency 20)

2. Subsoiler - breaks up soil at deeper than normal depths. (Transparency 21)

3. Rotary tiller - PTO powered blades spin to break up soil. (Transparency 22)

4. Rotary cultivator or hoe - curved teeth mounted on wheel which lift soil as they turn, packs soil if pulled backwards. (Transparency 23)

5. Rod weeders - long rod pulled horizontally under ground to kill weeds. (Transparency 24)

V. Types of Planting Equipment.

A. Small grains. (Transparency 25)

1. Rows spaced 15-20 cm (6-8 inches)

2. Seed is dropped in furrow continuously.

B. Row crops. (Transparency 26)

1. Row spacings range from 15-105 cm (16-42 inches).

2. Seed spacings vary depending on the crop.

3. Seeds are dropped at intervals in furrow.

VI. Types of Chemical Applicating Equipment. (Transparency 27)

A. Mounted - tank and booms attached to tractor or truck.

B. Trail type - pulled by tractor or truck.

C. Self propelled - various types.

D. Anhydrous ammonia tank - contains ammonia under pressure which is incorporated with cultivator. (Transparency 28)

VII. Hay and Forage Harvesting Equipment.

A. Mowers. (Transparency 29)

1. Cuts with reciprocating knives on a cutter bar.

2. Can be mounted or pulled behind.

3. Can be located in front, at side, or behind.

4. Rotary disk mowers becoming popular.

B. Conditioners. (Transparency 30)

1. Runs hay between rollers to crack or crush stem.

2. Speeds drying.

3. Often built as attachment to mowers or windrowers.

C. Windrowers (rakes). (Transparency 31)

1. Some mowers will put swath in a windrow.

2. Various kinds of rakes.

D. Balers. (Transparencies 32 and 33)

1. Packs hay into tied bundle.

2. Small square or large round bales most common.

3. Automatic stacking wagons greatly reduce labor but are expensive. (Transparency 34)

E. Stackers.

1. Packs hay into tight stack.

2. Size of stacker may vary.

F. Forage harvesters. (Transparency 35)

1. Chops and throws or blows forage into wagon. (Transparency 36)

2. May pick up windrow or row crop.

VIII. Grain and Row Crop Harvesting Equipment.

A. Grain windrower (swather). (Transparency 37)

1. Cuts grain and lays in windrow.

2. May be self propelled or pull type.

B. Combines. (Transparency 38)

1. Removes seed from rest of plant, called threshing.

2. May be self propelled or pull type.

3. May have cutting head to "straight" combine.

4. Various other heads used for row crops. (Transparency 39)

C. Lifters. (Transparencies 40 and 41)

1. Lifts root crop out of ground.

2. Used with beets or potatoes.

IX. Material Handling Equipment.

A. Elevating equipment.

1. Auger elevators. (Transparency 42)

a. Turning action spins grain upward.
b. Most common for grain.

2. Flight elevators (Transparency 43)

a. Chains or slats carry material upward.
b. May be used with a wider variety of materials.

1. Corn cobs.
2. Bales.

3. Blowers.

a. Air forces material through tube.
b. Can be used in a variety of situations.

B. Grain dryers. (Transparency 44)

1. Fan blows heated or unheated air through grain.

2. May be stationary or portable, gas or electric.

C. Grinders. (Transparency 45)

1. Grinds feed for livestock.

2. PTO or electric powered.

D. Waste handling equipment.

1. Manure spreaders. (Transparency 46)

a. Beaters break up and spread load.
b. Slats pull load backward to unload.

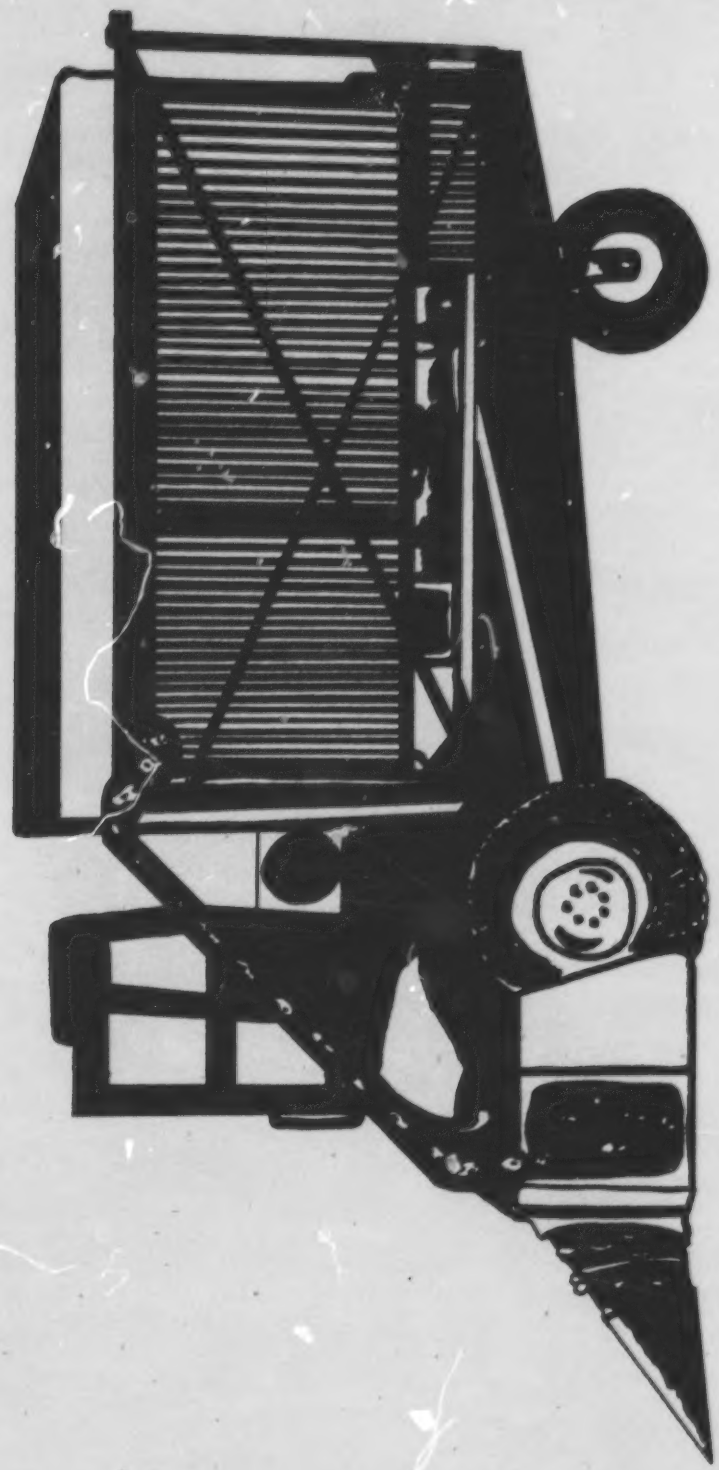
2. Liquid spreaders. (Transparency 47)

a. Pumps liquid waste into tank.
b. Usually unloaded by gravity.

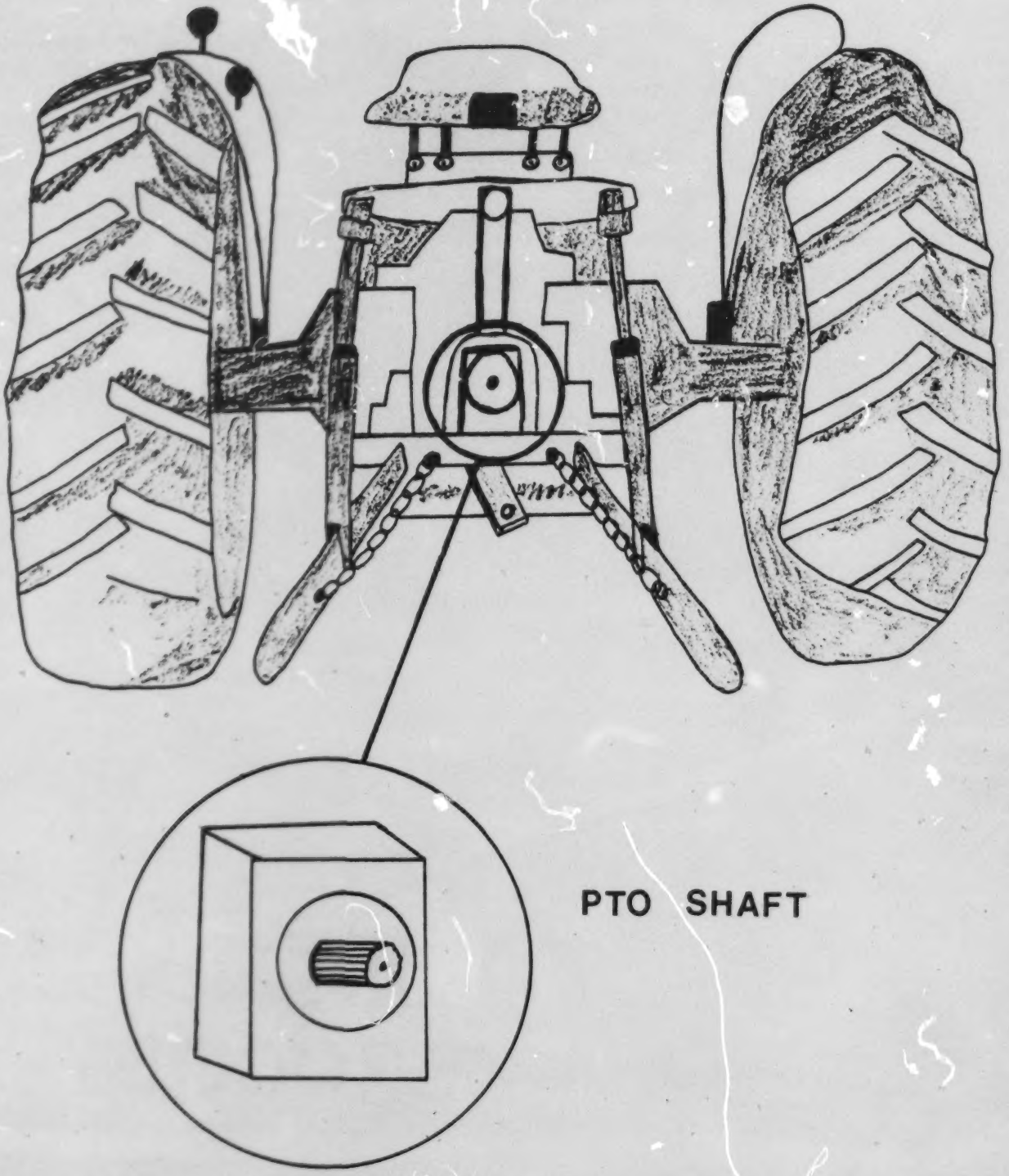
Student Learning Activities:

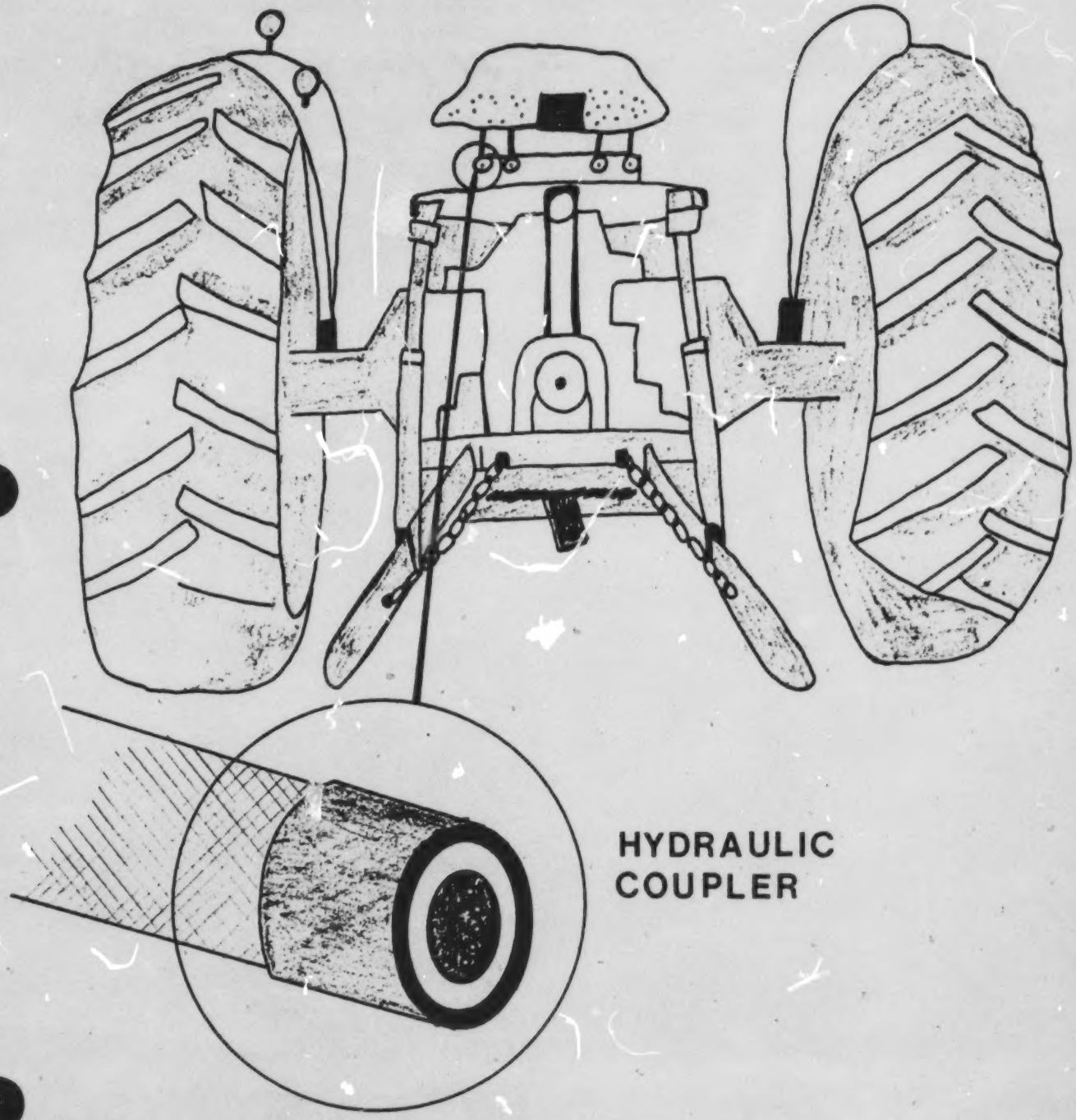
1. Have students search through magazines to find pictures of each kind of tractor and machinery.

2. Take students on a field trip to a local machinery dealer and look at various types of tractors and machinery.

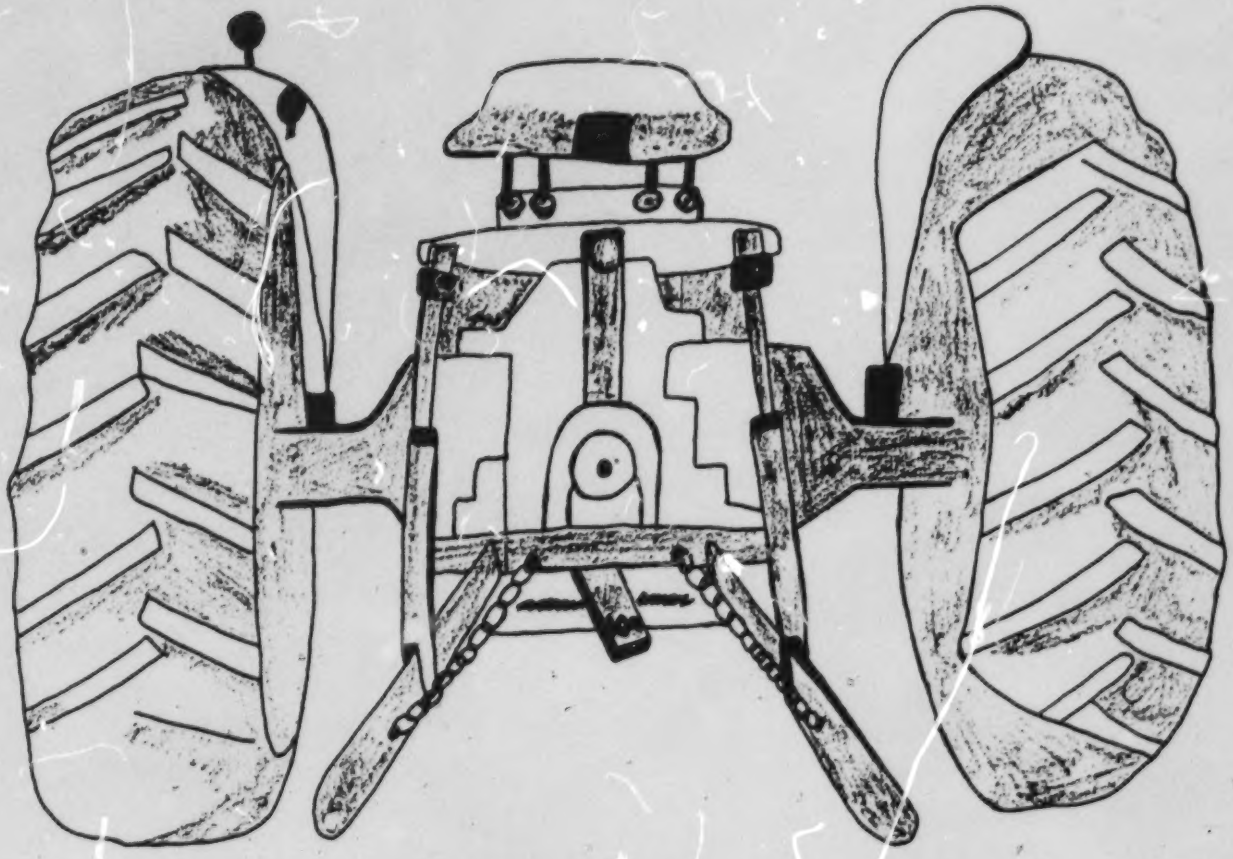


Courtesy of Vocational Instructional Services, Texas A&M University, College Station, Texas


PTO SHAFT



HYDRAULIC
COUPLER

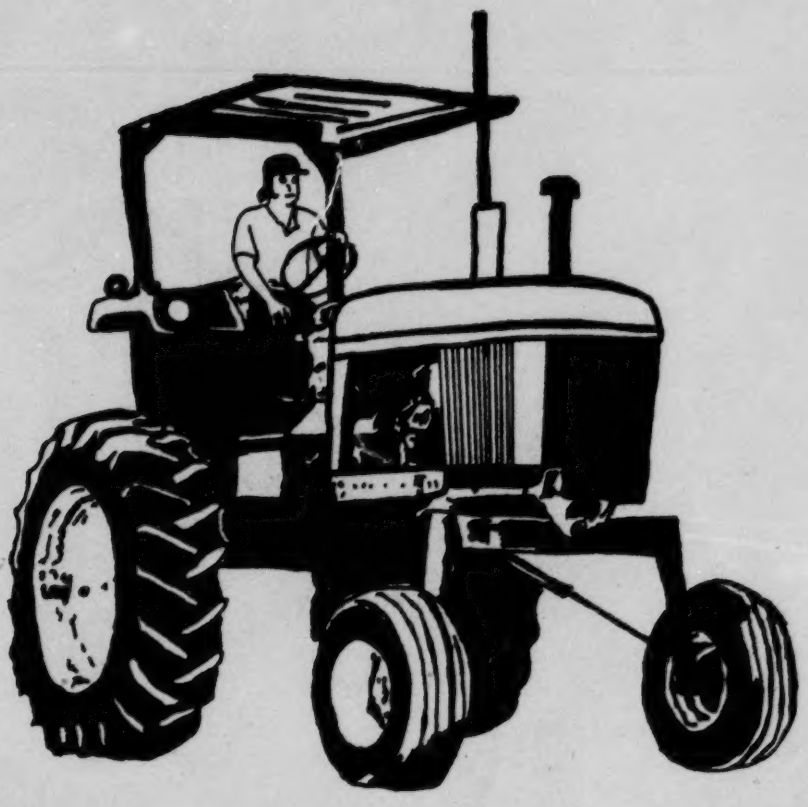


THREE POINT HITCH

DUAL REAR TIRES

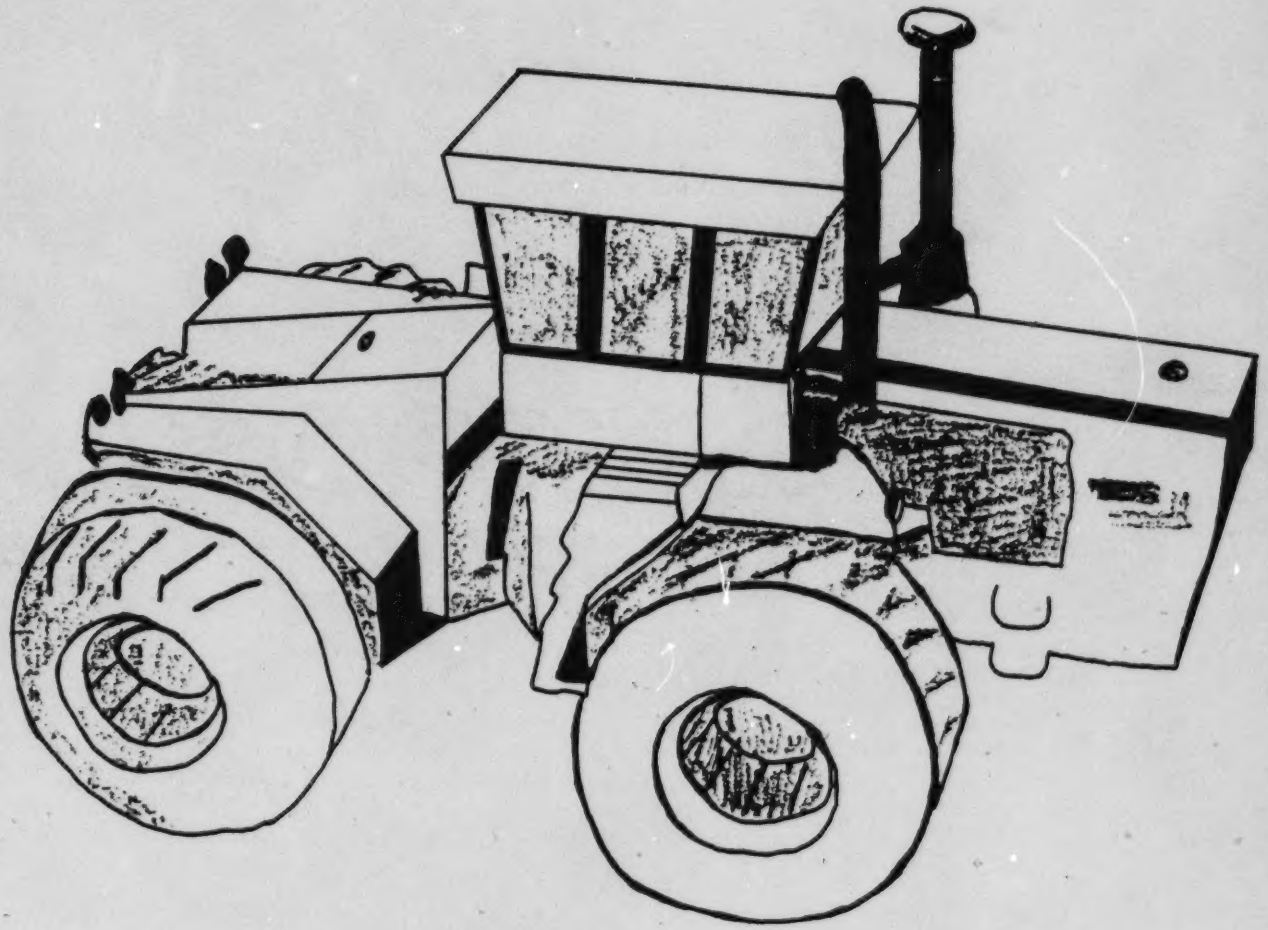
TRICYCLE TYPE TRACTOR

WIDE FRONT AXLE TRACTOR



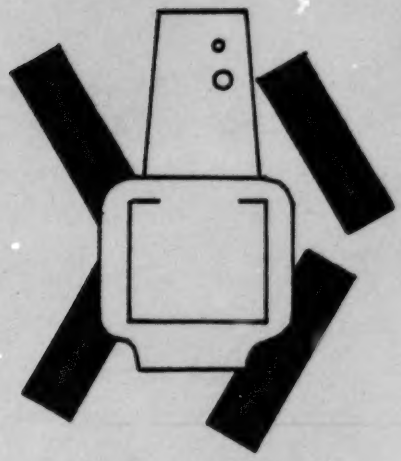
HIGH CLEARANCE TRACTOR

LOW PROFILE TRACTOR

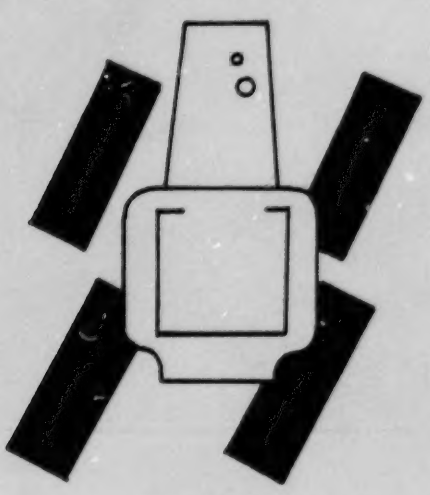


FOUR WHEEL DRIVE TRACTOR

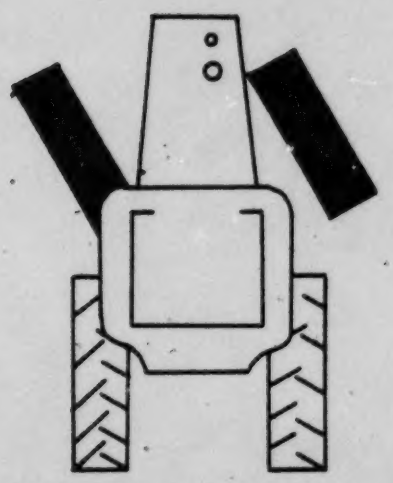
FOUR WHEEL DRIVE STEERING TYPES



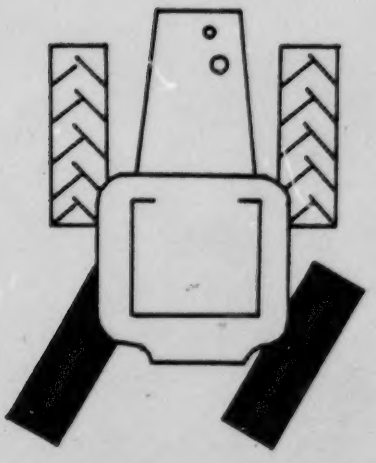
FOUR WHEEL



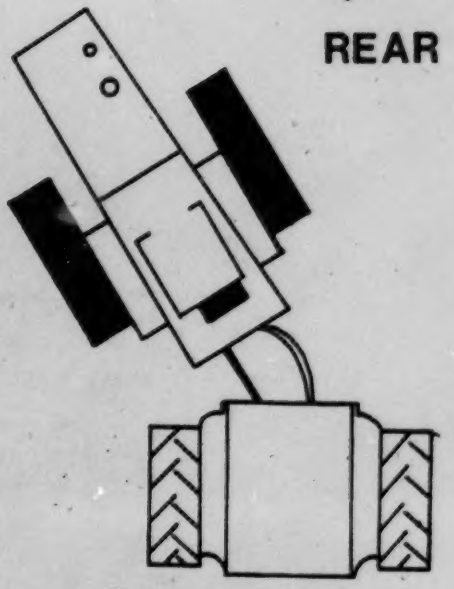
CRAB



FRONT WHEEL



REAR WHEEL



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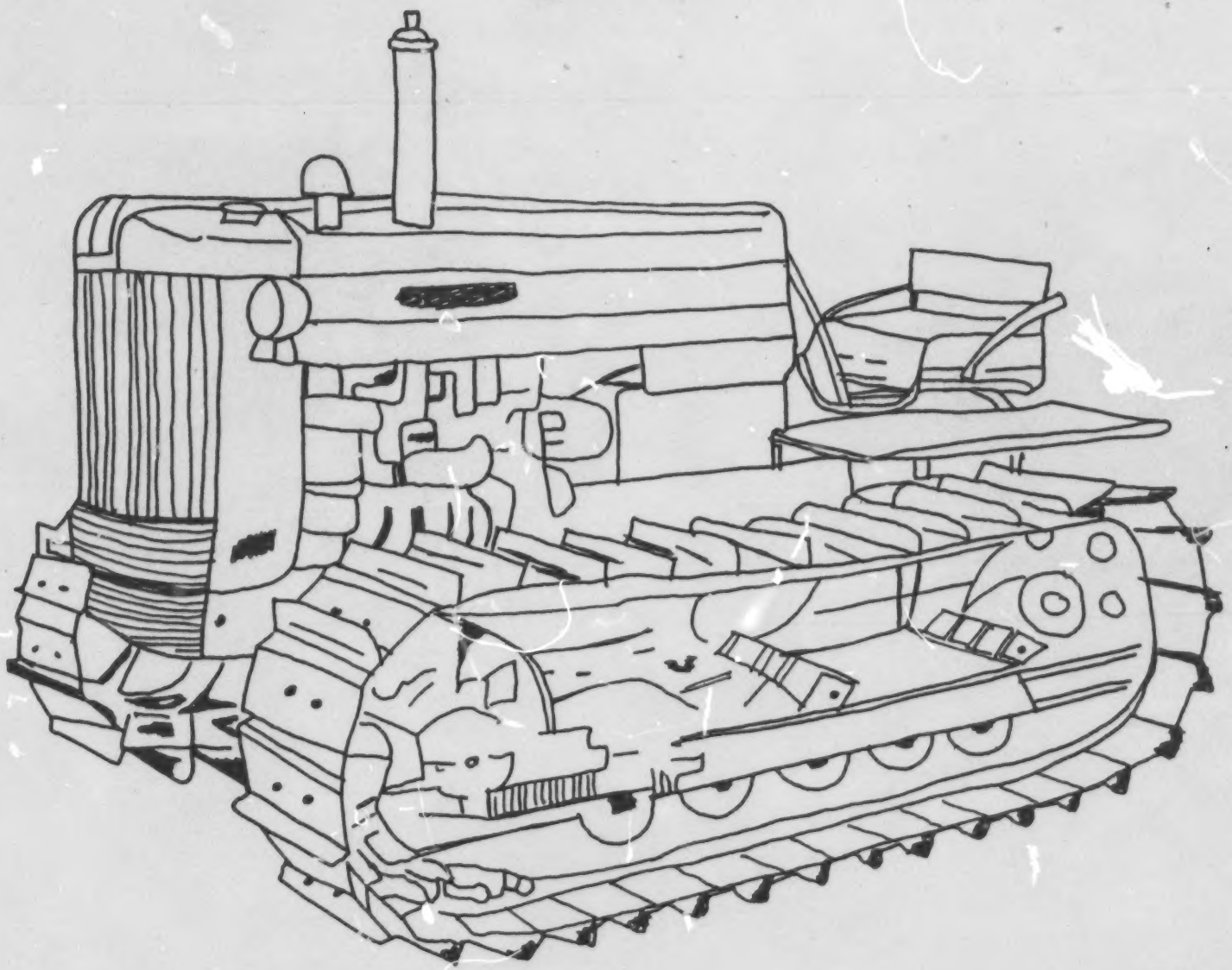

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27

CRAWLER TRACTOR

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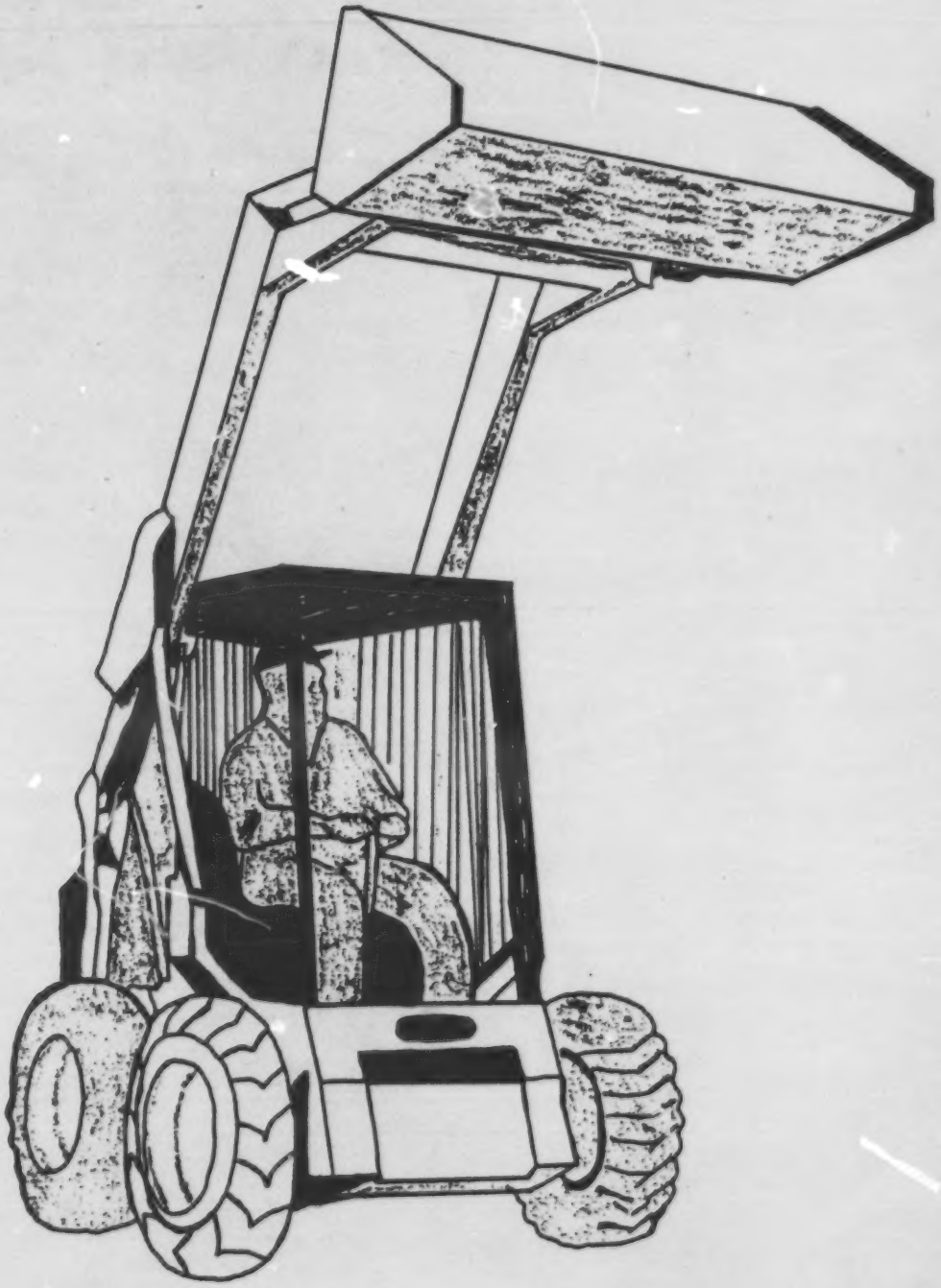
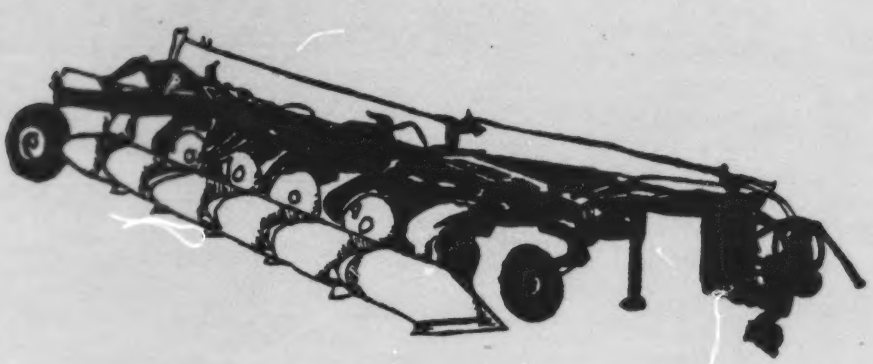
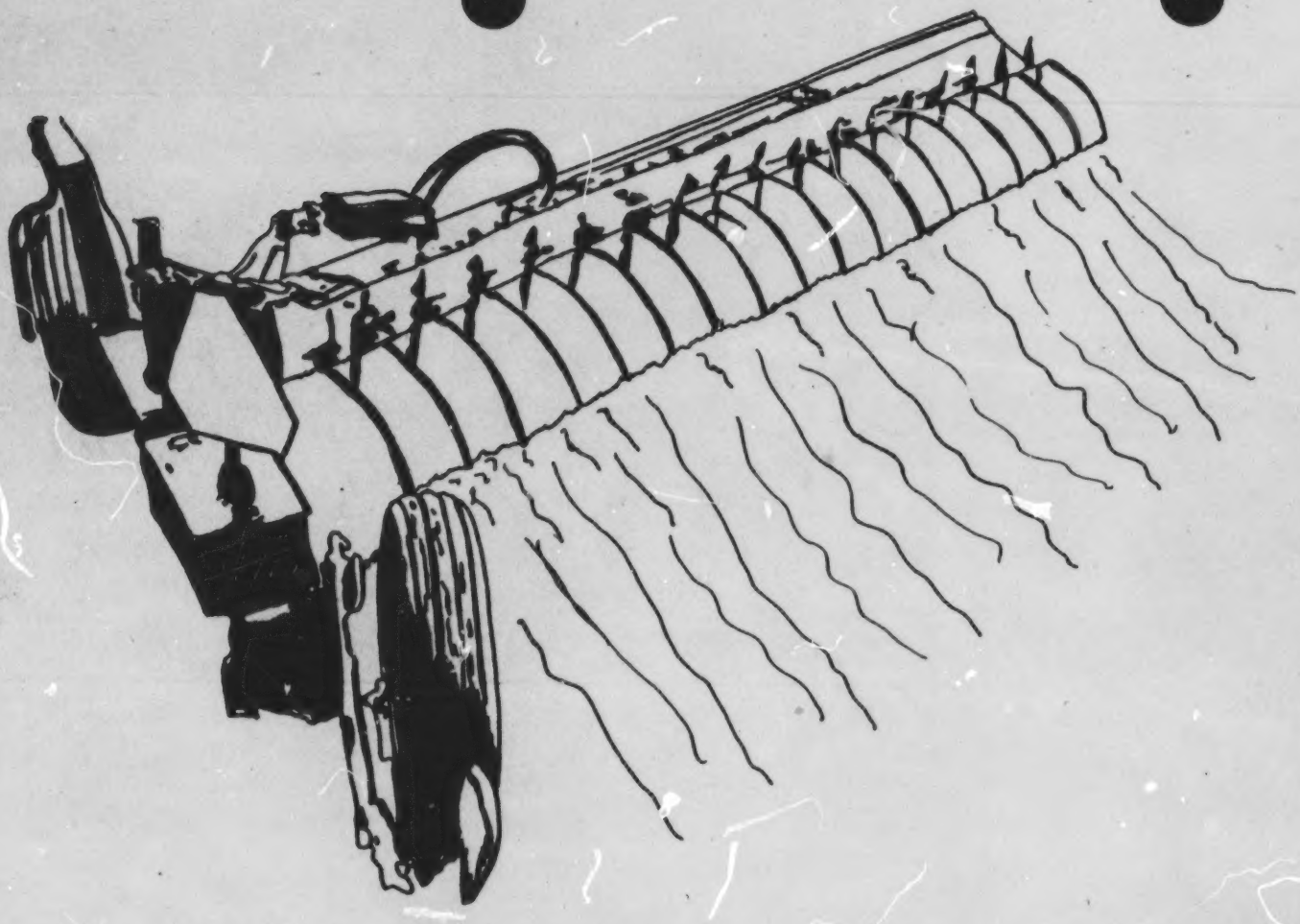
TM 13



SKID STEER LOADER TRACTOR

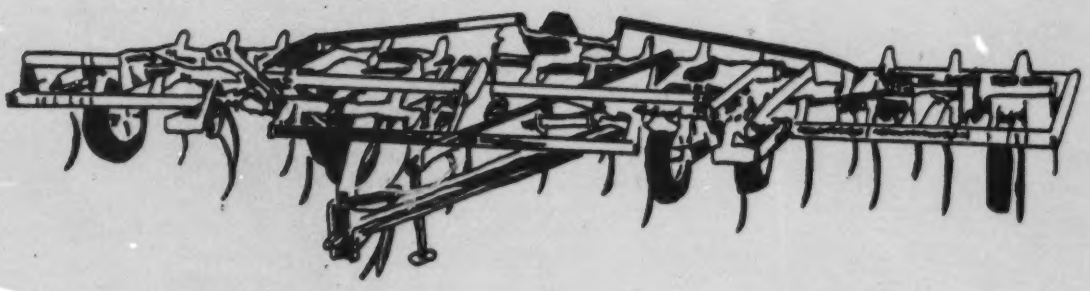


MOLDBOARD PLOW

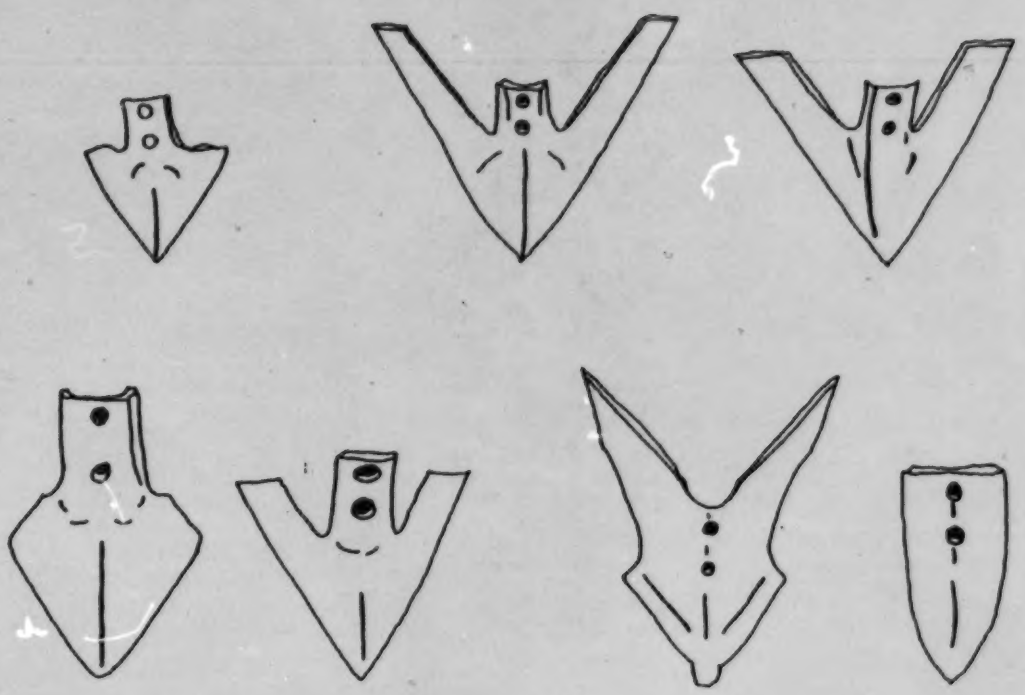


DISK TILLER

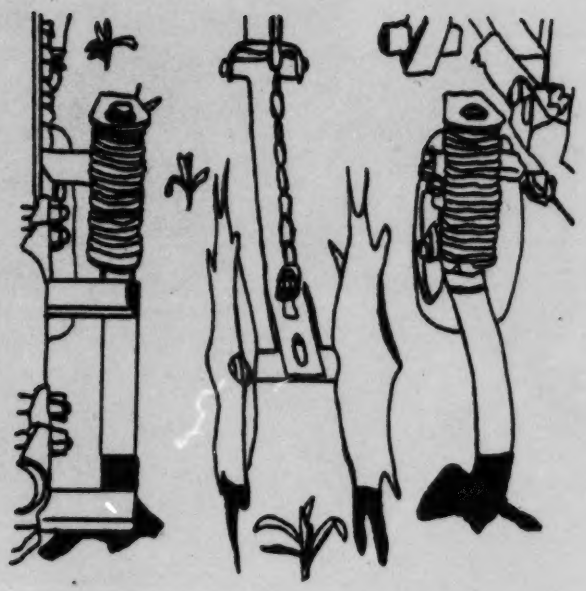
26 A-9-1 TM 15



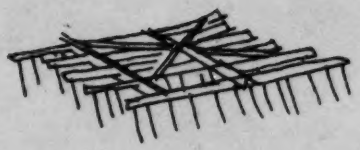
CHISEL PLOW



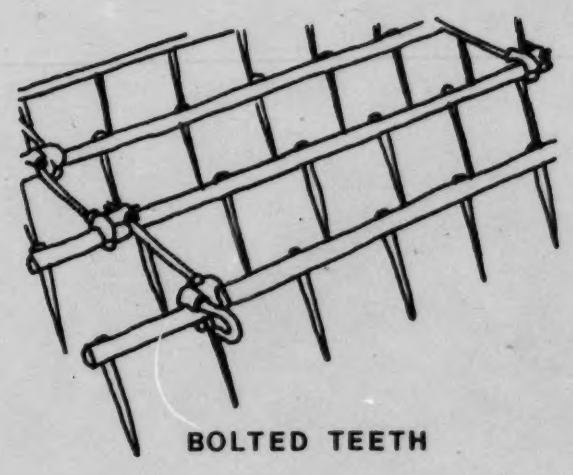
VARIOUS TYPES OF SWEEPS AND SHOVELS



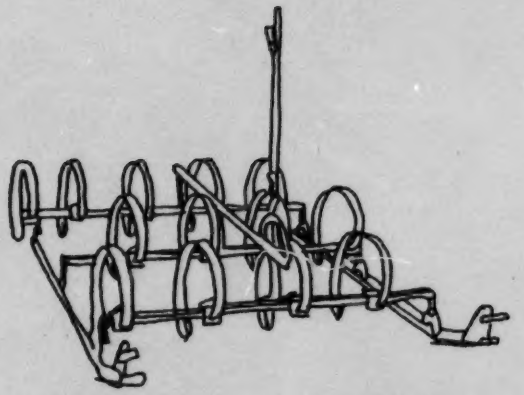
ROW CROP CULTIVATOR WITH ROLLING SHIELD



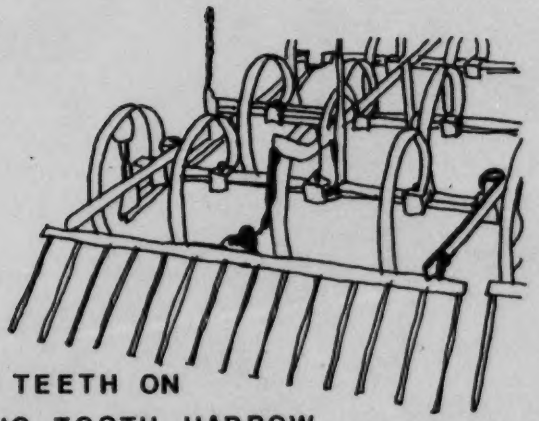
TINE - TOOTH HARROW



BOLTED TEETH



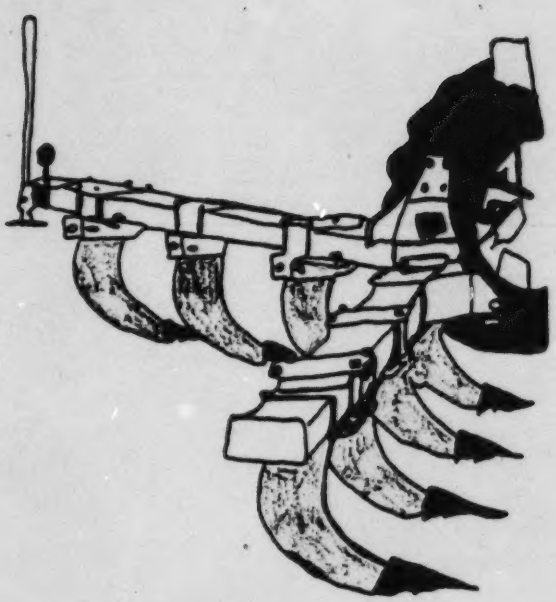
SPRING TOOTH HARROW



TINE TEETH ON
SPRING TOOTH HARROW

VARIOUS TYPES OF HARROW TEETH

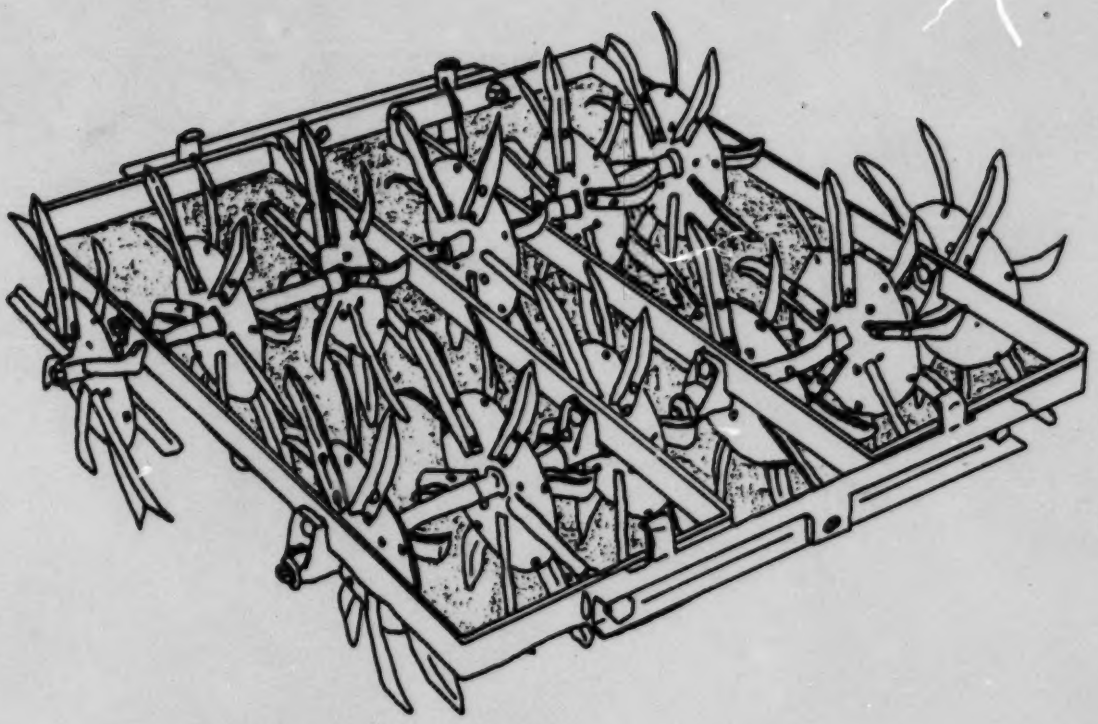
STUBBLE — MULCH PLOW



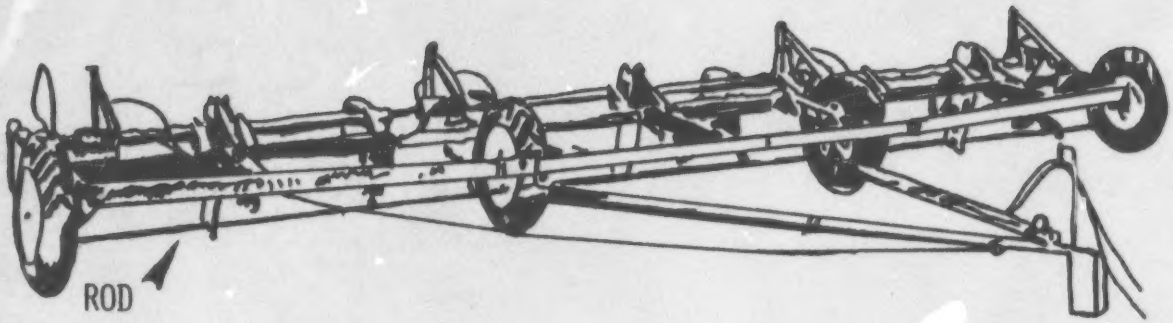
SUBSOILER

A-9-1
TM 22

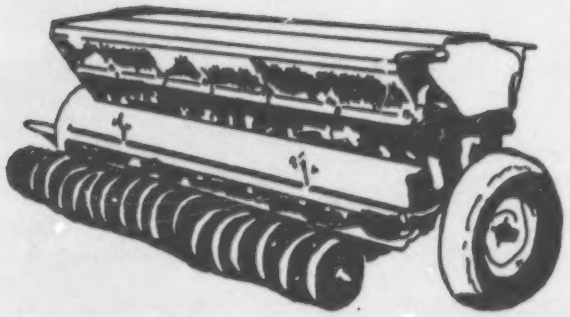
ROTARY TILLER



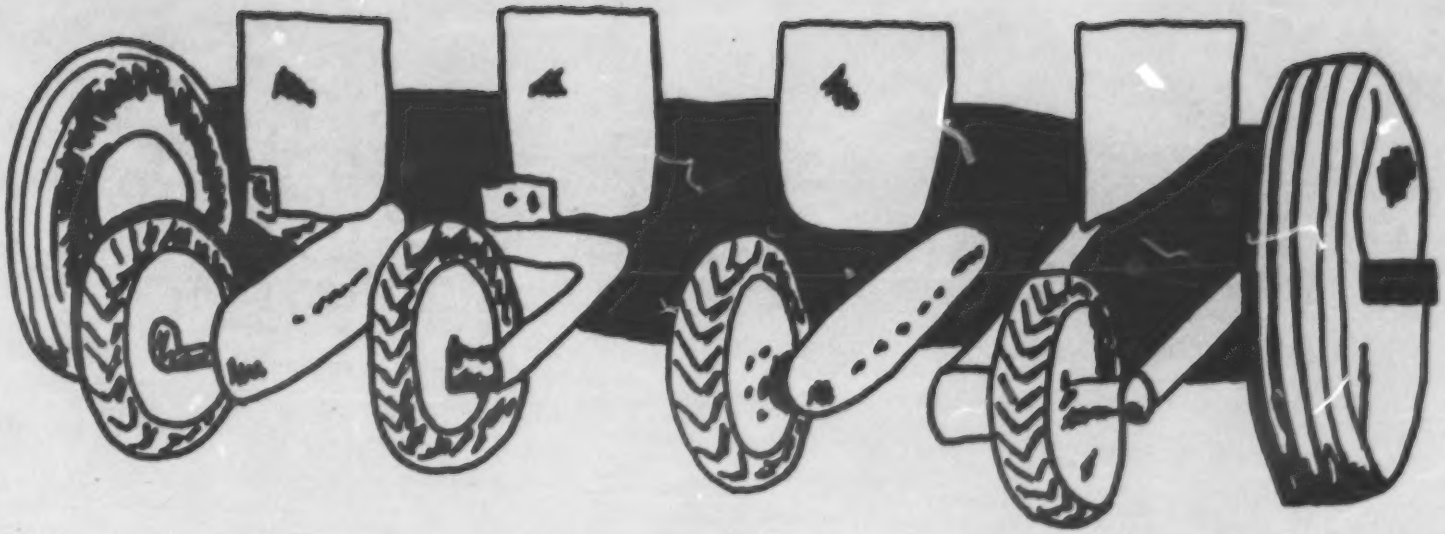
ROTARY HOE



ROD WEEDER

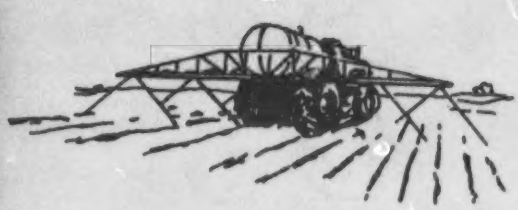


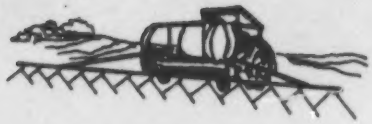
GRAIN DRILL

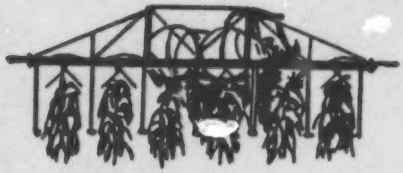


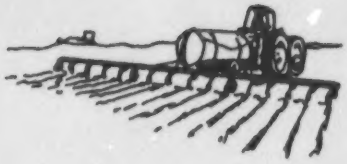
ROW CROP PLANTER

A-9-1
TM 2674
37





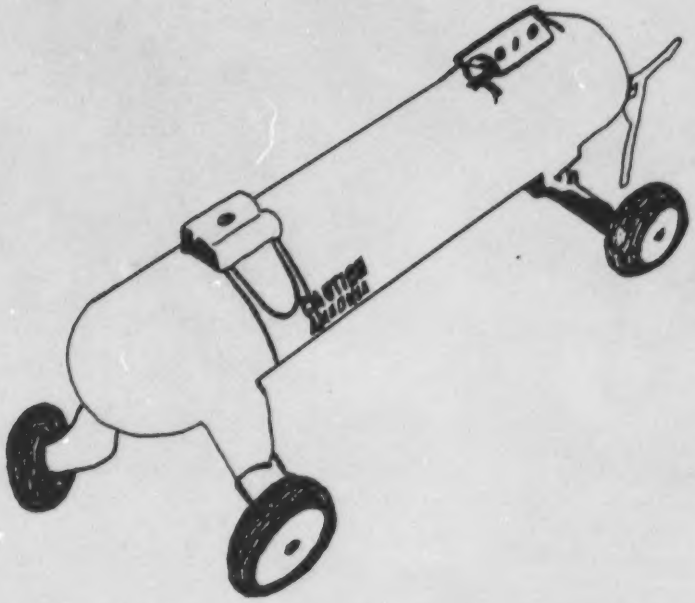




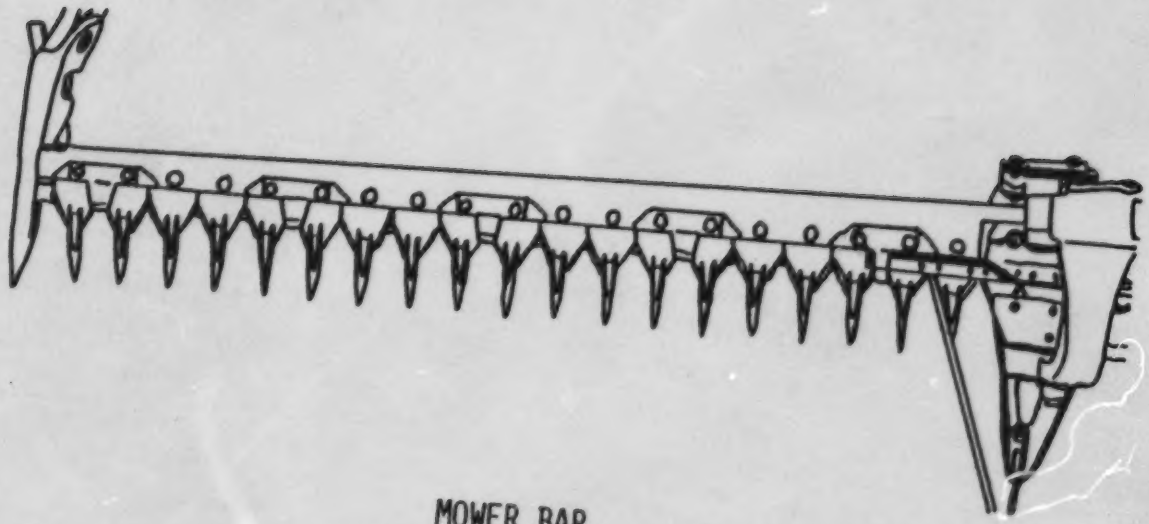
VARIOUS TYPES OF SPRAYERS

38

A-9-1
TM 27



ANHYDROUS AMMONIA TANK



MOWER BAR

47

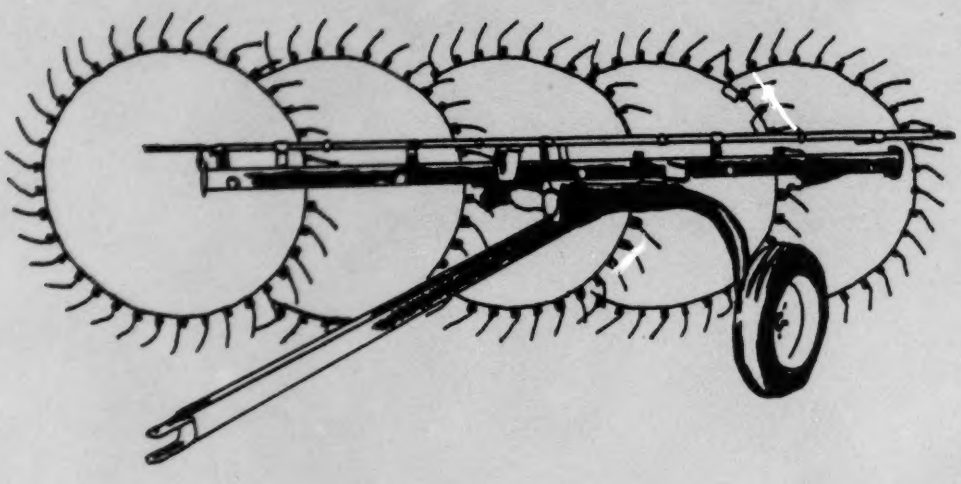
40

A-9-1
TM 29

48

MOWER AND CONDITIONER

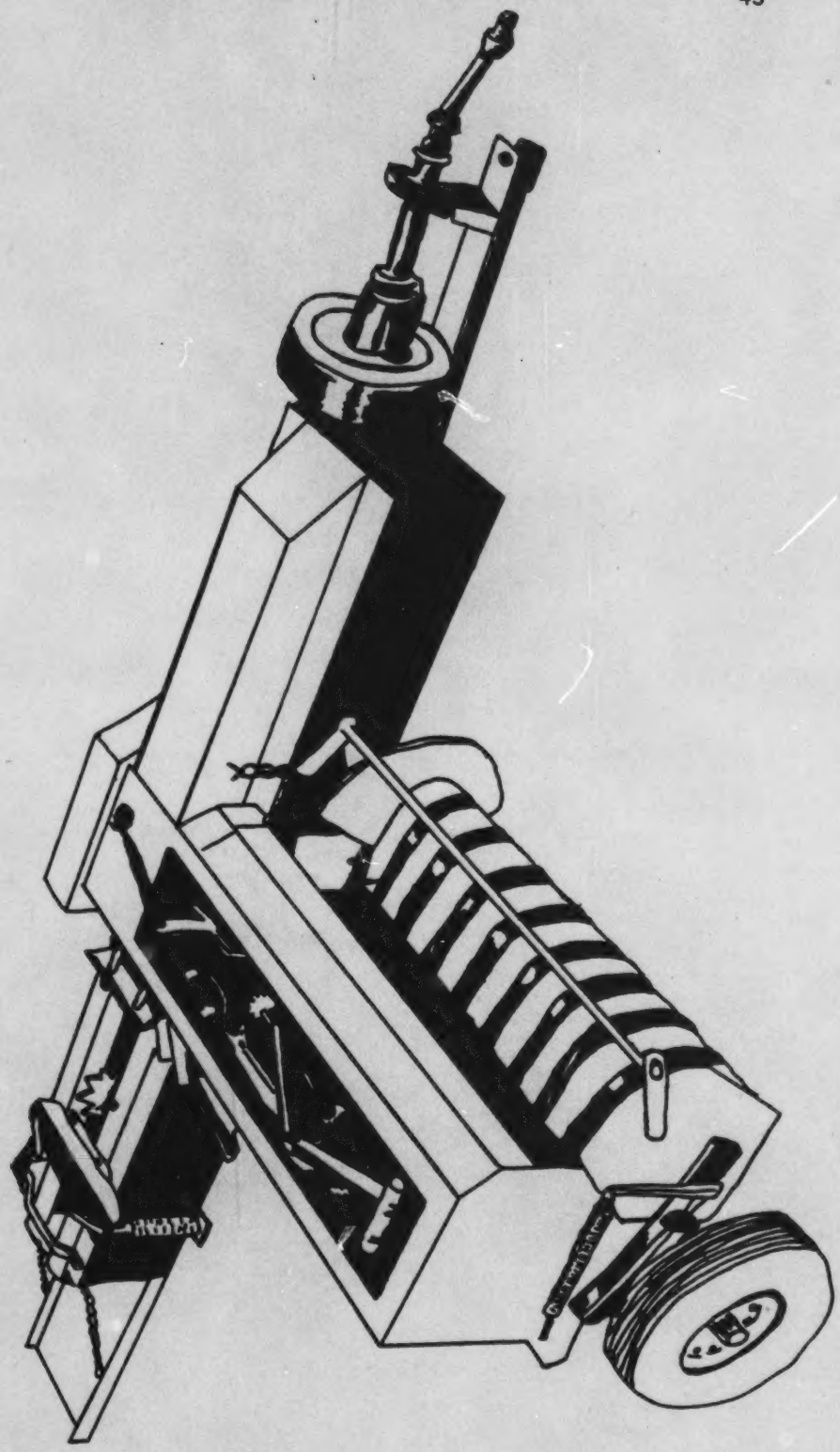
Courtesy of Vocational Instructional Services, Texas A&M University, College Station, Texas



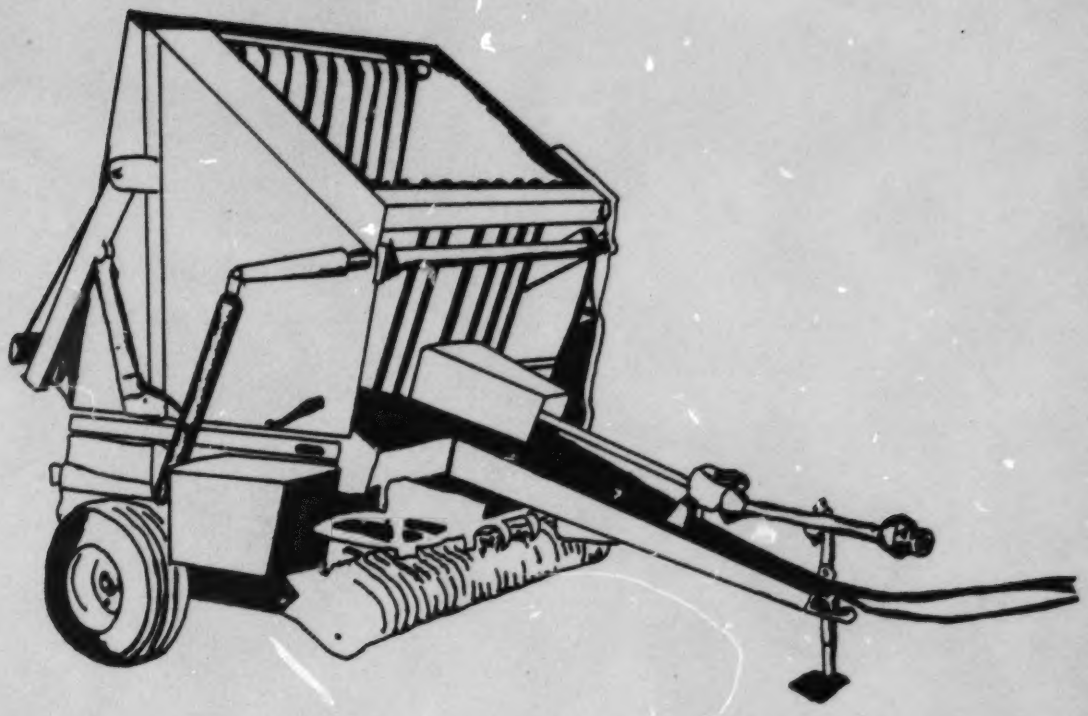
WHEEL RAKE

A-9-1
TM 32

HAY BALER



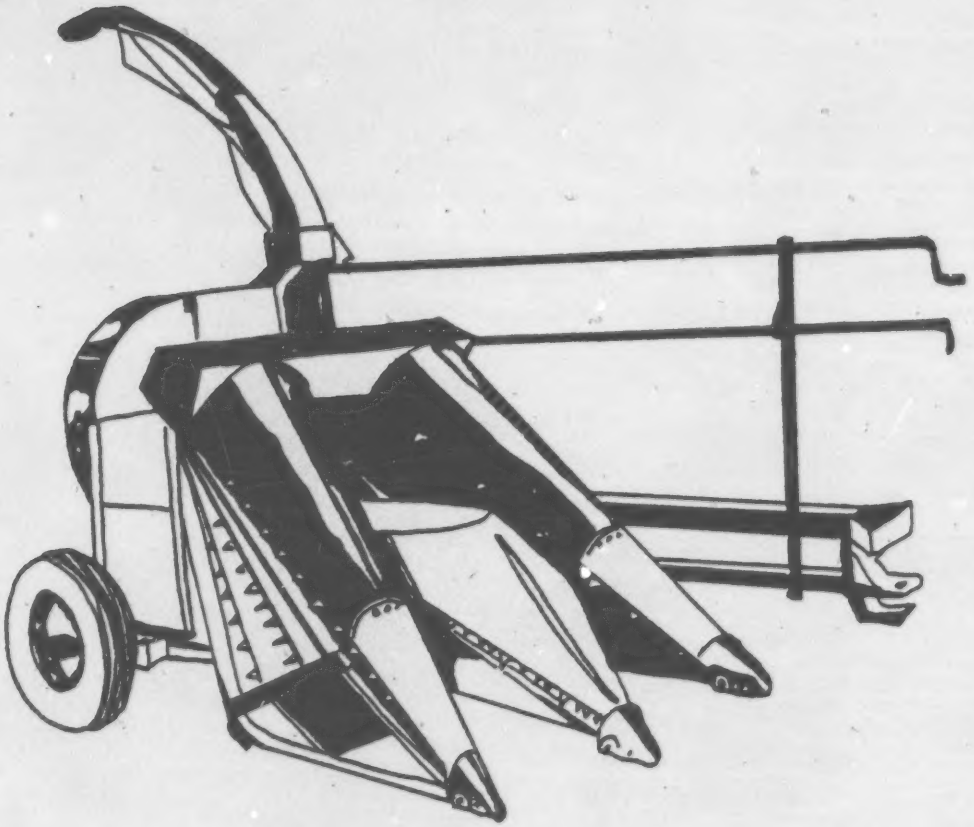
Courtesy of Vocational Instructional Services, Texas A&M University, College Station, Texas



LARGE ROUND BALER

AUTOMATIC STACKER

ROW CROP FORAGE HARVESTER



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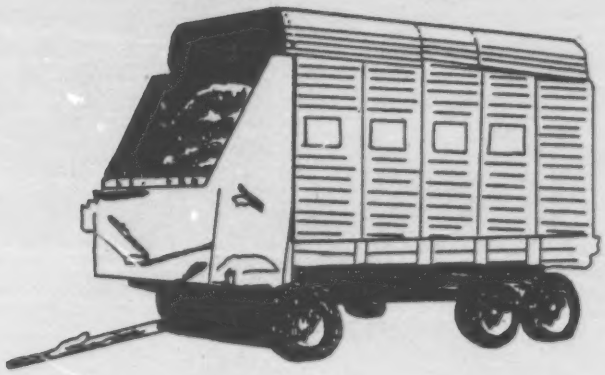
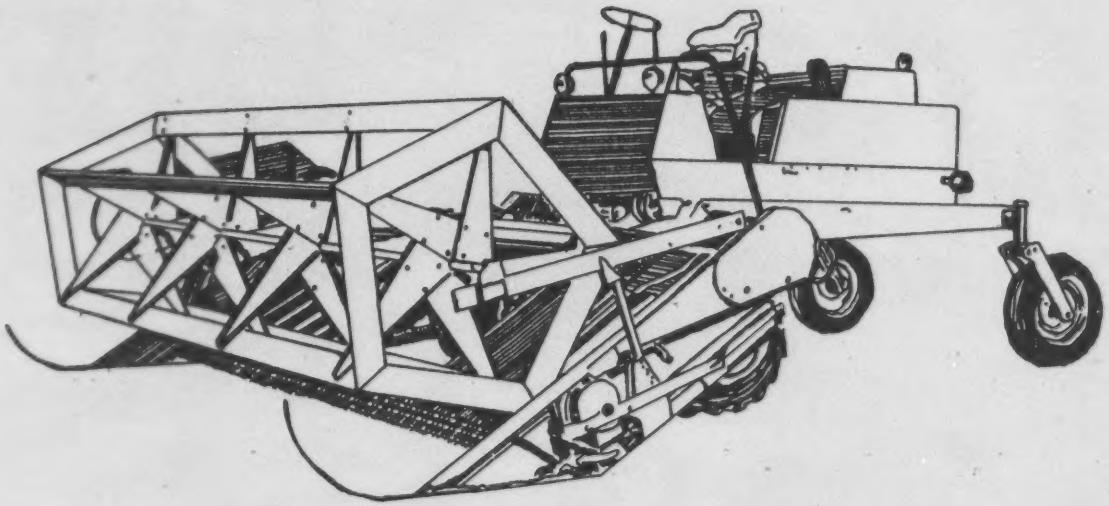
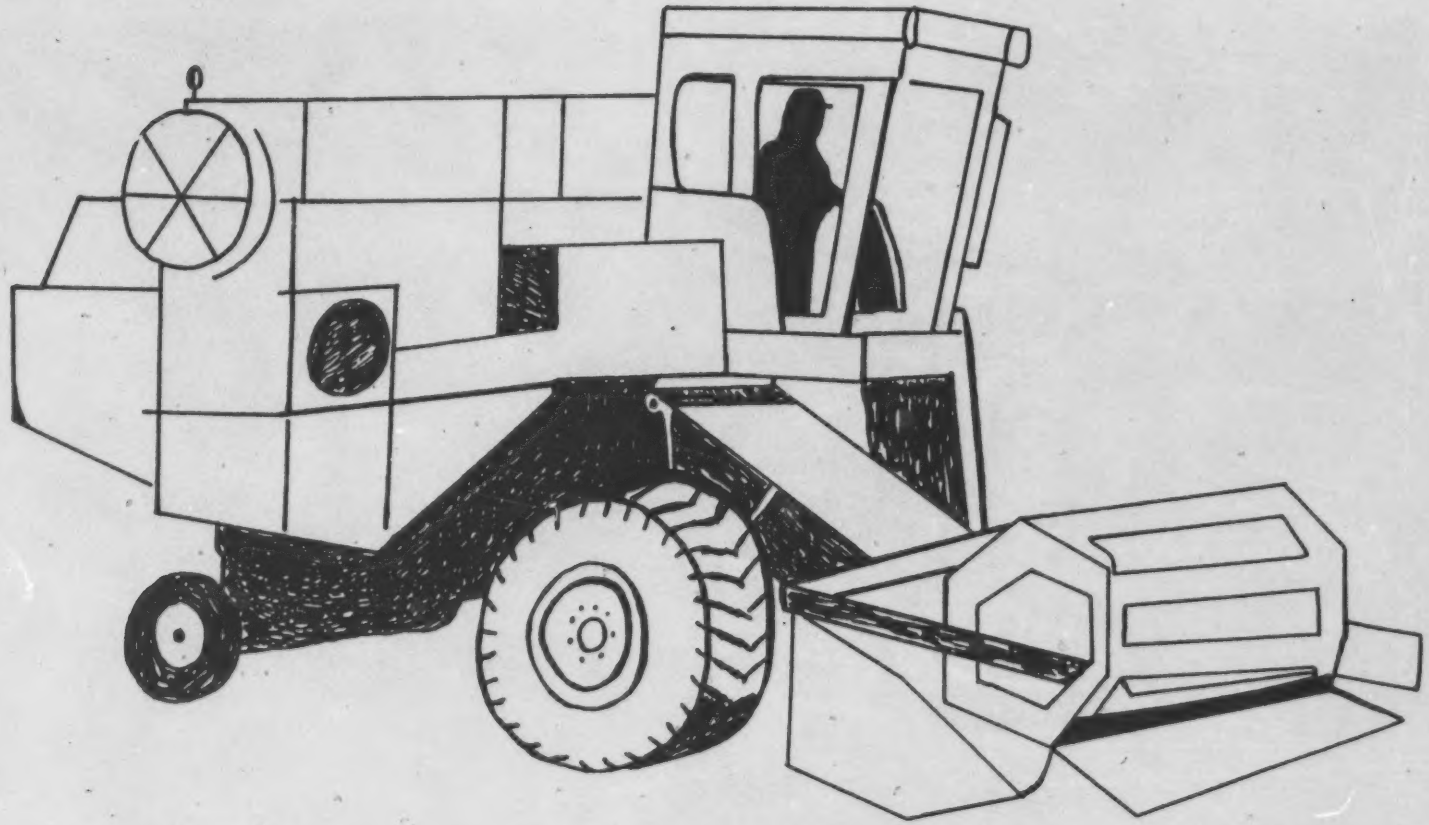


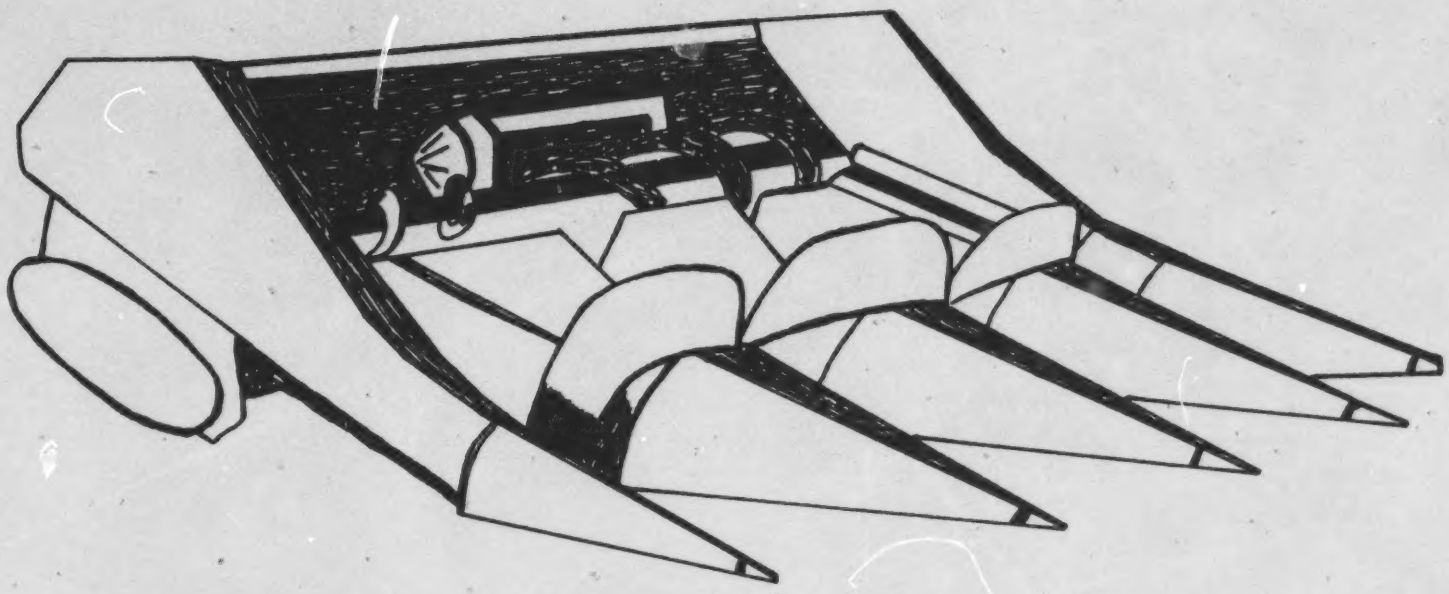
FORAGE WAGON



GRAIN WINDROWER

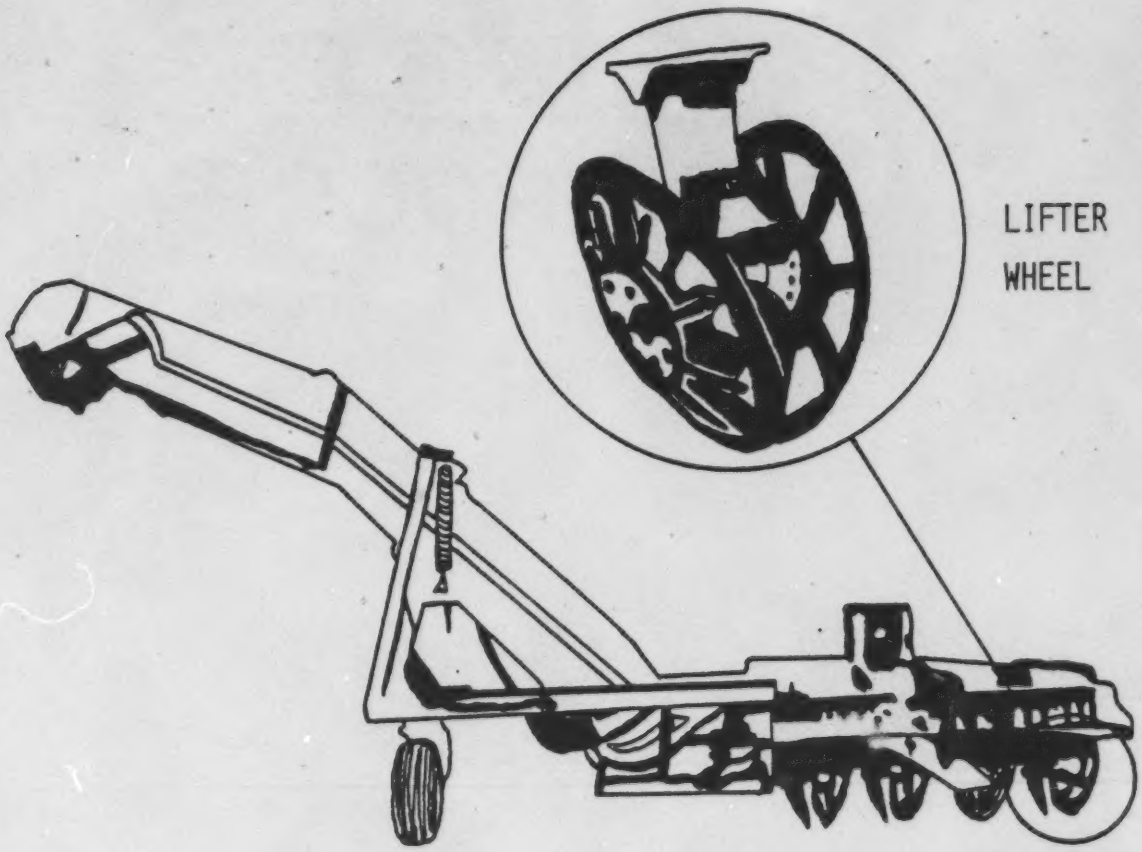


COMBINE WITH GRAIN HEADER



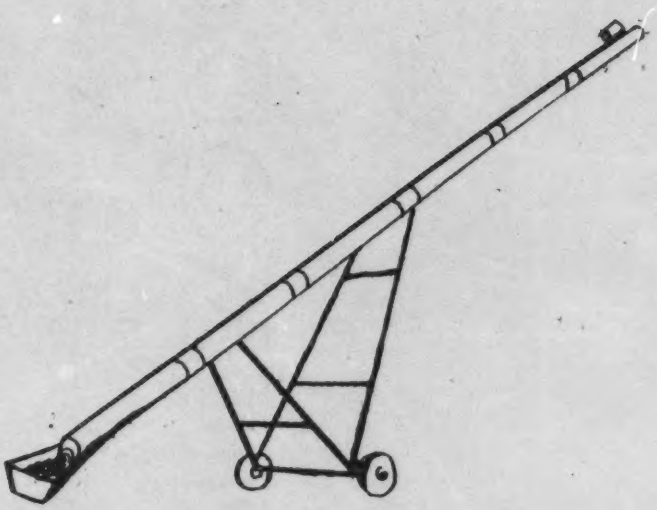
ROW CROP HEADER

BEET LIFTER

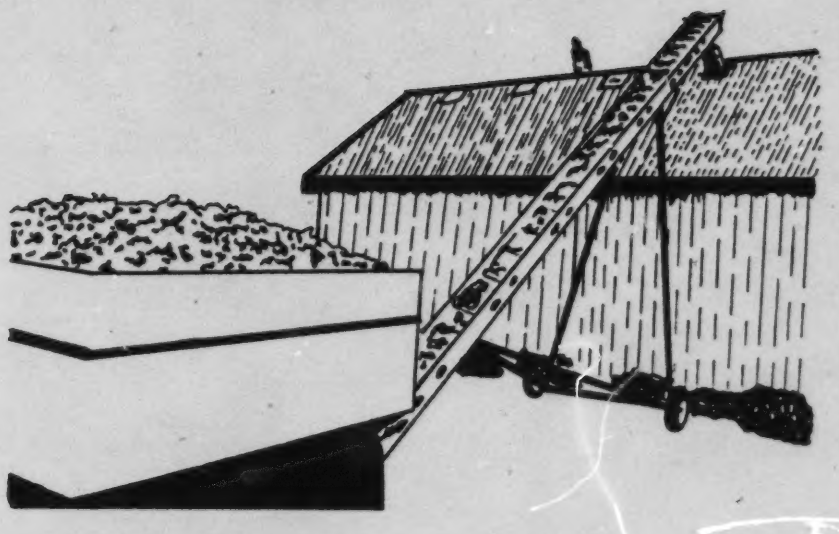


POTATO HARVESTER

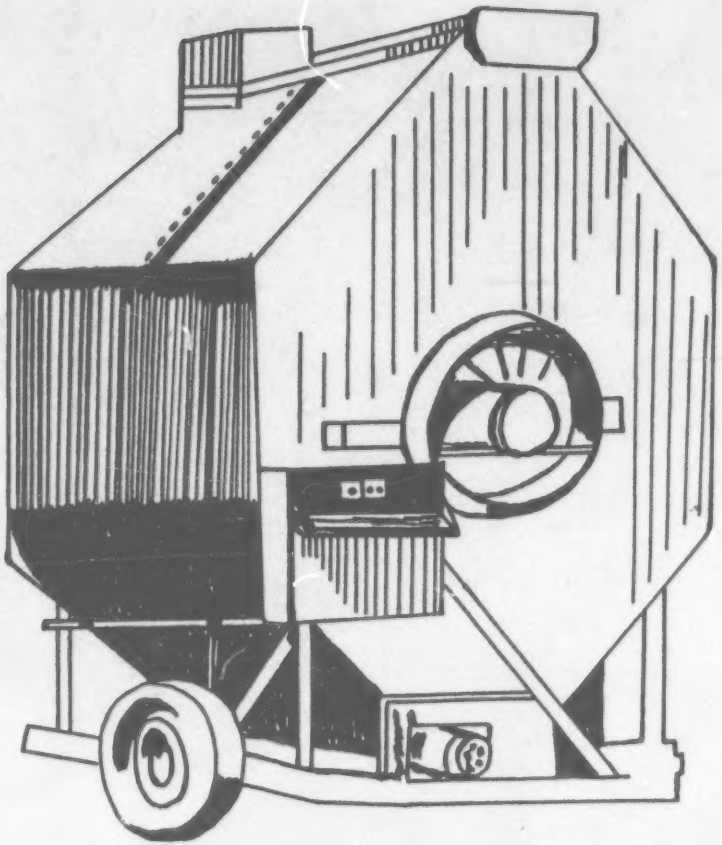
Courtesy of Vocational Instructional Services, Texas A&M University, College Station, Texas



GRAIN AUGER

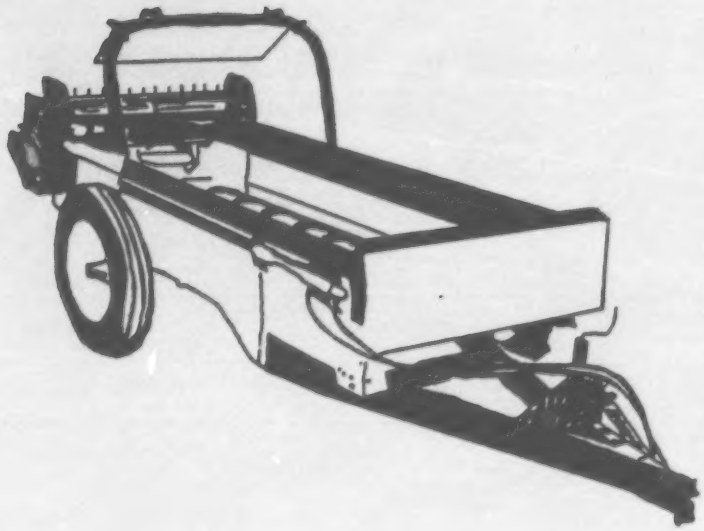


FLIGHT ELEVATOR LOADING
EAR CORN

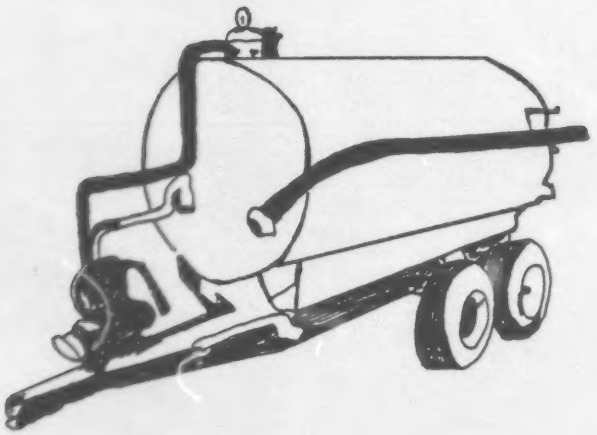


PORTABLE
GRAIN DRYER

FEED GRINDER



MANURE SPREADER



LIQUID MANURE SPREADER

Job 2: Understanding Farm Accident Prevention.

Objectives:

The objectives of this job shall be met at a level predetermined by the instructor. The manner in which they are evaluated shall also be determined by the instructor.

Upon completion of this job, the student shall be able:

1. To understand the importance of farm accident prevention.
2. To list fire safety measures involving tractor fuels.
3. To list fire safety measures involving stored hay and grain.
4. To identify classes of fires.
5. To identify and use types of fire extinguishers.
6. To list in order the steps involved in fighting fires.
7. To list characteristics of safe tractors and tractor operators.
8. To list safety measures involved in preventing tractor overturn.
9. To list safety measures involved in preventing other types of tractor and machinery accidents.
10. To list safety measures involving chemicals and gases.
11. To list the procedure for treating chemical burn and poisoning victims.
12. To list safety measures involving overhead power lines.
13. To list the procedure for action if contact is made with power lines.
14. To list causes and prevention of grain bin suffocation.

Guide Questions:

1. Why is farm accident prevention important?
2. How can fires be prevented?
3. How can tractor accidents be prevented?
4. How can accidents with chemicals and gases be prevented?

5. How can power line accidents be prevented?

6. How can grain bin suffocation be prevented?

References:

Accident Facts. National Safety Council, Chicago, Illinois, 1977.

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Fire Prevention on the Farm and Ranch. National Safety Council, Chicago, Illinois.

New Facts About Fuels. International Harvester.

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Phipps, Lloyd J. Mechanics In Agriculture. Danville, Illinois: The Interstate Printers and Publishers, Inc., 1977.

Portable Fire Extinguishers. National Safety Council, Chicago, Illinois.

Principles of Pesticide Use, Handling, and Application. Office of Pesticide Programs, Environmental Protection Agency, January 1976.

Safe Operation of Agricultural Equipment - Instructor's Manual. Cooperative Extension Service, North Dakota State University, Fargo, North Dakota.

Safe Use of Farm Fuels. National Safety Council, Chicago, Illinois.

Silletto, Thomas A. and Dale O. Hull. Safe Operation of Agricultural Equipment - Student Manual. St. Paul, Minnesota: Hobar Publications.

Interest Approach:

Relate incidences of actual farm accidents, those listed in Unit Nine of Safe Operation of Agricultural Equipment, or the following statistics to the students:

-- Most injuries of persons between 5 and 14 occur during recreation, but for ages 15 to 24 during field work or chores.

-- Truck accident injuries are highest for ages 15 - 24.

-- One fifth of tractor and machinery accidents occur with ages 15 - 24.

-- Although ages 45 - 64 have more severe and permanent injuries, ages 15 - 24 have more fatal injuries.

-- Most likely cause of death for persons under 24 is an accident.

-- If the fatality was a tractor accident, it most likely tipped and rolled completely over, and was on level or nearly level ground.

Key Facts:

I. Importance of Farm Accident Prevention.

A. Agriculture is third most hazardous industry in U.S. (Transparency 1)

1. Mining and construction are more hazardous.

2. Farm resident accidents (1979).

a. Deaths - 4200.

1. Over one half were motor vehicle.
2. Thirty percent were work related.
3. Over fifty percent of tractor fatalities were overturns.

b. Disabling injuries - 380,000.

1. One third were work related.
2. Over one fifth were motor-vehicle.
3. Forty percent were doing either field work or routine chores.

c. Injuries by severity and age. (18 state survey) (Transparency 2)

1. Two thirds of all injuries were severe.
2. Age 45 - 64 had more severe and permanent injuries, but age 15 - 24 had more fatal injuries.

B. North Dakota accident statistics.

1. Accidents leading cause of death for ages 1 - 34.

2. North Dakota ranks 13th in accidental death rates in the U.S. (Transparency 3)

3. Sixty percent of all work related accidents were in agriculture. (Transparency 4)

4. Most tractor fatalities occurred when either: (Transparency 5)

a. Tractor ran off highway.
b. Driver or rider fell off and was run over by tractor or trailing machinery.
c. Tractor tipped over.

II. Fire Prevention.

A. Fuel safety.

1. Highly explosive.

a. One gallon of gasoline can equal 14 sticks of dynamite.
b. Air currents can carry vapors as far as 30 meters (100 feet) to an ignition source. (Transparency 6)
c. Gasohol and "winter gas" are more volatile.

1. Can create excessive tank pressure.
2. Release more vapors when cap is removed.

d. Fumes are heavier than air and will settle in low areas.

2. Fuel storage.

a. Underground storage is best.
b. Above ground tanks should be 15 meters (50 feet) from buildings.
c. Post NO SMOKING signs around tank.
d. Check cap to make sure pressure does not build up in tank.

1. Pressure-relief cap best.
2. Vented cap allows excess evaporation.

3. Fuel containers.

a. Safety cans should be used.

1. Shape makes them difficult to tip.
2. Cap automatically closes if it does tip.
3. Screen prevents sparks from igniting fuel.

b. Never put can in trunk unless it is left open.

1. Vapors cannot escape and build up inside.
2. Slightest spark could cause explosion.
3. If can must be transported by car, it should be in back seat with windows open to vent fumes.

c. Gasoline cans should be red, diesel should be green, both should be labeled.
d. Should not use gasoline can for diesel or vice versa.

4. Misuse of fuels.

a. Do NOT use as a cleaning agent or solvent.
b. Do NOT use to start fires.

5. Rules for fuel safety.

a. Always tighten cap securely.

b. Never remove cap or refuel when engine is running or hot.
c. Never smoke when refueling or anywhere near fuel.
d. Don't fill the tank to capacity, allow room for expansion.
e. Wipe up any spills immediately.
f. Keep your equipment properly maintained.
g. Keep your equipment clean, free of trash and oil.
h. Don't drive near open fires.
i. Never use fuel for cleaning parts.
j. Schedule your gasoline purchasing so that you won't hold "winter gas" over until spring in storage tanks.
k. Make sure everyone operating your equipment follows all the safety rules in the operator's manual.
i. Display warning signs by storage tanks and on vehicles. (Transparency 7)

6. Safety check for tractors. (Transparency 8)

a. Check exhaust system for broken manifolds, loose exhaust pipes, broken mufflers, leaking gaskets.
b. Check for fuel leaks at connections of lines, sediment bowls, fuel cap, and carburetors.
c. Check electrical wiring for frayed or cracked insulation and loose connections.
d. Be sure fuel tank heat shields are in place.
e. Use only the correct fuel cap and be sure it's in good condition and vent is open.

B. Stored hay and grain.

1. Too high moisture content will cause heating and may start fire.

2. Should be harvested or dried to proper moisture content.

3. Do not store wet hay or grain.

4. Check for warm spots, if over 80° C (175° F) remove or divide into small stacks or piles.

5. Grass silage must have adequate moisture to prevent heating.

6. Should watch silo for:

a. Heat.
b. Release of vapor.
c. Steaming.
d. Smoke.
e. Charred tobacco smell.

C. Planning ahead for fires.

1. Plan escape routes from buildings.

2. Practice fire drills.

3. Use smoke and heat detectors in home and buildings.

4. Keep fire extinguishers handy and maintained.

D. Classes of fires.

1. A - Ordinary combustible.

   a. Wood, paper, etc.
   b. Common examples on farm would include buildings, straw or chaff, heating grain or sunflowers.

2. B - Flammable liquids.

   a. Gasoline, paint thinners, etc.
   b. Common examples on farm would include fuel storage tanks, fuel in vehicles and grain dryers, paints and paint thinners.

3. C - Electrical.

   a. Wires, fuseboxes, electric motors.
   b. Common examples on farm would include electric motors on farm equipment, wires and extension cords.

4. D - Combustible metals.

   a. Magnesium.
   b. Not common on farms.

E. Types of fire extinguishers. (Transparency 9)

1. Pressurized water.

   a. Sprays water to cool burning material.
   b. Used only on Class A fires.

      1. Class B may spread liquid and float on top.
      2. Class C may cause shock to operator.

2. Soda acid.

   a. Soda combines with acid to create pressure.
   b. Used only on Class A since main ingredient is water.
   c. Generally considered obsolete and should be replaced.

3. Foam.

   a. Chemical foam is sprayed on fire to smother it.
   b. Used only on Class A and B.

4. Carbon dioxide (CO_2).

   a. CO_2 is discharged over fire to smother it.
   b. Used on Class B and C.
   c. Can be used on small Class A fires if some other agent such as water or sand is used with it.

5. Dry chemical.

   a. Various types of chemical used to spray dust cloud over fire.
   b. Regular dry chemical type used on Class B and C.
   c. Multipurpose dry chemical type used on Class A, B, and C.

F. Storage and maintenance of fire extinguishers.

1. Should be located near exits of buildings and on each self-propelled vehicle.

2. 3 to 6 meters (10 - 20 feet) from fuel storage.

3. Too close to fire hazard may make extinguisher hard to get to when needed.

4. Should be hung in plain view and clearly marked.

5. CO_2 and dry chemical extinguishers should be weighed annually to insure maximum effectiveness.

6. All others should be recharged annually.

7. All pressurized extinguishers (those not operated by a hand pump) should by hydrostatically pressure checked every five years.

   a. Indicate corrosion or mechanical injury.
   b. Should be done by a manufacturer, service agent or other qualified person.

8. All extinguishers should be recharged and replaced after use.

9. Pressurized water must have an antifreeze added to prevent freezing.

10. Soda acid and foam type must be kept warm, cannot add antifreeze.

11. No extinguisher should be stored at over 50° C (120° F).

G. Operating fire extinguishers.

1. Pressurized water.

   a. Remove from wall.
   b. Remove locking pin.

c. Squeeze discharge lever and aim at base of fire working from side to side.
d. Do not aim at flames or smoke.

2. Soda acid.

a. Remove from wall and carry in upright position.
b. Grab bottom handle and turn extinguisher over to mix soda and acid.
c. Aim at the base of fire working from side to side.

3. Foam. (Transparency 10)

a. Remove from wall and carry in upright position.
b. Grab bottom handle and turn extinguisher over.
c. Spray stream lightly on fire or deflect it off the floor or wall so foam flows over fire.

4. CO_2 (Transparency 11)

a. Remove from wall.
b. Remove locking pin.
c. Must stand close to fire.
d. Squeeze trigger and aim at base of fire lifting upward.
e. Nozzle gets extremely cold, don't touch it.
f. In subzero weather, leave valve open, do not spray intermittently.
g. Stand by in case fire reflashes.

5. Dry chemical.

a. Remove from wall.
b. Remove locking pin.
c. Squeeze trigger and aim at base of fire.
d. Trigger may be located on top of extinguisher or end of hose.
e. If it doesn't spray immediately, tap extinguisher to loosen packed chemical.

H. Fire fighting procedure. (Transparency 12)

1. Get people out of building or away from fire.

2. Sound the fire alarm.

a. Alarm system in building.
b. Call fire department.

3. Remove livestock if possible without danger.

4. Do NOT attempt to fight fire until steps 1 and 2 are done, and then only if fire is not out of control.

5. Fire in building.

   a. Stay near exit, don't get trapped.
   b. Stay low to avoid smoke.
   c. Don't ventilate room until fire is out.
   d. Don't open a door if top of door or doorknob is hot, or pressure felt when opening door just a crack.

6. Engine fires.

   a. Shut off engine.
   b. Disconnect battery if possible.
   c. Use CO_2 or dry chemical extinguisher.
   d. Watch out for spilled gas.

7. Grass fires.

   a. Make a 120 cm (4 feet) fire break by raking, digging, or wetting.
   b. Work as a team.

      1. First one knocks down flames.
      2. Second follows behind to put out sparks.

8. Clothing on fire.

   a. Do NOT run.
   b. Roll on ground to extinguish flames.

III. Tractor Accident Prevention.

A. Safe operator.

1. Characteristics.

   a. Mature in judgment and responsibility.
   b. Observes safety precautions.
   c. Doesn't take chances.
   d. Uses up-to-date safety equipment.
   e. Concerned for safety of others.
   f. Maintains a safe environment.
   g. Plans ahead, doesn't rush job.
   h. Proud of work.
   i. Knows the machine.
   j. Keeps good maintenance records.
   k. Knows his own limits.
   l. Recognizes hazards.

2. Wears personal protective equipment when appropriate.

   a. Bump cap.
   b. Safety glasses.
   c. Ear protection.
   d. Gas or dust masks.
   e. Rubber gloves and apron.
   f. Steel toed shoes with puncture proof soles.

3. Takes breaks when appropriate rather than working when tired or sleepy.

B. Safe tractor.

1. Properly serviced (Discussed in Job 4.)

2. Properly equipped.

a. Slow moving vehicle emblem (SMV). (Transparency 13)
b. Roll over protective structure (ROPS). (Transparency 14)
c. Shields for PTO and other moving parts.
d. Fire extinguisher approved for Class B fires.
e. First aid kit.

3. Properly repaired.

a. All missing shields replaced.
b. Tractor in good running condition.

C. Tractor stability.

1. Most tractor accidents involve overturn.

2. Tractor will overturn when the center of gravity is outside the stability base line. (Transparency 15)

a. Center of gravity is balancing point of tractor.
b. Stability base line is determined by rear wheels and front axle hinge.

3. Additional forces increasing tendency to overturn. (Transparency 16)

a. Centrifugal force by short turns.
b. Rear axle tongue lifting front end.
c. Leverage from high hitch.

D. Preventing overturn.

1. Avoid quick turns.

2. If tractor is accidently driven off road grade, do not attempt to turn back up, but should turn down into ditch.

3. Avoid starting up steep hills under load. (Transparency 17)

4. Back up steep inclines.

5. Avoid obstructions.

6. Back out when stuck. (Transparency 18)

a. Do NOT fasten post to rear wheels.
b. Do NOT go forward unless being pulled.

7. Hitch only to drawbar or regular hitch points. Check operator's manual for proper height. (Transparency 19)

8. Use care and drive slowly when crossing or working along shallow ditches or waterways. (Transparency 20)

9. Cross slopes slowly. Look out for dips, raises, rocks, gullies, etc., that could trigger upset. (Transparency 21)

10. Use tractor for the jobs it's designed to do. (Transparency 22)

11. Add front end weight with heavy load on drawbar or 3 point hitch. (Transparency 23)

12. Move slowly with load on front end. Keep load down to lower center of gravity. (Transparency 24)

13. Select safe speed for each job. Slow down when turning. (Transparency 25)

E. Preventing other tractor and machine accidents.

1. Use SMV emblems on all machinery. (Transparency 26)

2. Always place trailing machine in transport position. (Transparency 27)

3. Obey all traffic regulations.

4. Don't rely on hydraulic system to hold machinery up when working around equipment. Block machinery. (Transparency 28)

5. Make sure all machine parts have stopped before cleaning or adjusting machinery. (Transparency 29)

6. Don't allow riders. (Transparency 30)

7. Shut off engine and relieve pressure when working with hydraulic connections. Jet stream from even a pinhole leak can penetrate flesh.

8. Use caution around any moving parts. (Transparency 31)

9. Use caution around batteries.

   a. Battery acid very corrosive and could cause burns.
   b. Hydrogen gas being produced is highly explosive, spark could ignite it.

10. Use caution around augers. Make sure shields are in place.

11. Don't try to dislodge any kind of pickup or feeder device without shutting off power source. Reaction time is too slow to let go. (Transparency 32)

12. Display appropriate safety alert symbols. (Transparency 33)

    a. Danger - red.
    b. Caution - yellow.
    c. Warning - yellow.

13. Use some kind of hearing protection.

    a. Ear plugs.
    b. Ear muffs.
    c. Insulated cab.

IV. Preventing Accidents With Chemicals And Gasses.

A. Pesticides.

1. Ways of entering the body.

    a. Swallowed orally.
    b. Through the skin.
    c. Inhaled.

2. Label warnings. (Transparency 34)

    a. DANGER -(skull and crossbones)- POISON - Highly Toxic.
    b. WARNING - moderately toxic.
    c. CAUTION - slightly toxic.

3. Transporting pesticides.

    a. Never carry inside car or truck cab.
    b. Secure containers to keep from rolling or bouncing. (Transparency 35)
    c. Never transport feed, seed or groceries in the same load.
    d. Never allow children to ride on or near pesticides.

4. Mixing and handling pesticides.

    a. Use neoprene or rubber gloves and apron, goggles, and a respirator if needed. (Transparency 36)
    b. Mix only what will be used.
    c. Mix according to the label.
    d. Avoid splashes, spills, and drift.
    e. Do not combine pesticides unless approved.
    f. Change clothes immediately in case of a splash or spill.
    g. Stand with your head well above fill hole of spray tank. (Transparency 37)
    h. Stay with tank during filling.

5. Reasons for not applying on windy days.

    a. Injury to wild life, plants, pollinators, and livestock.
    b. Contamination of ponds, streams, rivers, and lakes.
    c. Increase in inhalation and contact hazard to applicator.

6. Preventing exposure during application.

   a. Wear protective clothing and equipment.
   b. Do not wipe hands on clothing. Carry a special towel.
   c. Never blow out clogged hoses, nozzles or lines with your mouth.
   d. Never eat, drink, or smoke when handling pesticides.
   e. Work in pairs or at least let someone know where you will be working.
   f. Keep people, livestock, and pets out of spray area.

7. Equipment maintenance.

   a. Check for leaks in pump and tank.
   b. Check for leaky hose connections.
   c. Carefully dispose of worn or cracked hoses.

8. Basic first aid rules.

   a. Poison on skin.

      1. Act quickly.
      2. Remove contaminated clothes and drench skin with water.
      3. Cleanse skin and hair thoroughly with detergent and water.
      4. Dry victim and wrap in blanket.

   b. Chemical burn.

      1. Wash with large quantities of running water.
      2. Remove contaminated clothing.
      3. Cover burned area immediately with loose, clean, soft cloth.
      4. Do not apply ointments, greases, powders, or other drugs in first aid treatment of burns.

   c. Poison in eye.

      1. Wash eye quickly but gently.
      2. Hold eyelid open and wash with gentle stream of clean running water.
      3. Wash for 15 minutes or more.

      (CAUTION: Do not use chemicals or drugs in the wash water. They may increase the extent of the injury.)

   d. Inhaled poison.

      (NOTE: If victim is in an enclosed area, do not enter without proper protective clothing and equipment. If proper clothing is not available, call for emergency equipment from your fire department.)

1. Carry victim to fresh air immediately.
2. Get victim to a doctor.
3. Open all doors and windows so no one else will be poisoned.
4. Loosen tight clothing.
5. Apply artificial respiration if breathing has stopped or is irregular.
6. Keep victim as quiet as possible.
7. Prevent chilling.

9. When to induce or not to induce vomiting.

a. Read the label for instructions.
b. Never induce vomiting:

1. If the victim is unconscious or is in convulsions.
2. If the victim has swallowed a corrosive poison.

(NOTE: A corrosive poison is a strong acid or alkali. A corrosive poison will burn the throat and mouth as severely coming up as it did going down. It may also get into the lungs and burn there also.)

3. If the victim has swallowed emulsifiable concentrate or oil solutions.

(NOTE: Emulsifiable concentrates and oil solutions, like corrosive poisons, cause severe burns when vomited.)

c. Induce vomiting:

1. If victim has swallowed a noncorrosive poison.
2. If victim has swallowed a dilute form of petroleum product.
3. Procedure.

a. Give victim large amounts of milk or water.
b. Put finger or the blunt end of a spoon at the back of victim's throat or have victim drink a glass of salted water.

(CAUTION: Do not use anything which is sharp or pointed.)

10. MUST be 18 or older to apply chemicals. Tractor certification is not sufficient.

B. Anhydrous ammonia.

1. Causes burns by:

a. Freezing.
b. Caustic action.
c. Dehydration.

2. Safety measures.

   a. Use only proper equipment designed for anhydrous.
   b. Inspect equipment for loose connections, worn hoses, and improperly operating valves.
   c. Wear protective gear when transferring. (Transparency 38)
   d. Keep clean water nearby in a squirt bottle.

3. Treatment for burns.

   a. Flush with water for 15 minutes.
   b. May have to force eyes open.
   c. Do not apply salves, greases, or oils.

C. Gases.

1. Carbon monoxide (CO).

   a. Colorless and odorless.
   b. Never operate an engine unless room or exhaust is ventilated.

2. Other poisonous gases.

   a. Sources.

      1. Liquid manure pits.
      2. Silos.
      3. Septic tanks.

   b. Wear a self-contained breathing apparatus and use a safety rope when entering such areas. (Transparency 39)

V. Preventing Power Lines Accidents.

A. Reasons for increased risk.

1. Larger farms have more power lines.
2. Equipment is getting larger, often with fold-up wings.
3. Cabs reduce vision to see power lines.
4. Greater number of radio and CB antennas.

B. Safety measures.

1. Make sure all operators know where power lines are.
2. Use caution in moving large equipment. (Transparency 40)
3. Don't allow riders on top of bale wagons.
4. Don't stack hay under power lines.
5. Make sure truck box is completely lowered before driving away.
6. Lower auger before transporting. (Transparency 41)
7. Use caution with metal ladders, transport in a horizontal position. (Transparency 42)

8. Use caution when handling irrigation pipe, do not clean near power lines.

9. Locate steel bins and other buildings without power away from power lines. Maneuvering auger near them would greatly increase danger.

10. Use caution with loader tractors. (Transparency 43)

11. Lower antennas before driving under or have them mounted lower.

12. Place mounted antennas away from power lines in case they tip over. (Transparency 44)

13. Place warning signs where appropriate. (Transparency 45)

14. Keep phone number of power supplier near phone with other emergency numbers.

C. When contact with power line occurs:

1. With equipment.

a. Try to back away.
b. If you cannot, stay on equipment and call for help.
c. If you must leave, jump clear, do NOT step to ground.
d. Shut off power or call supplier.
e. Rubber tires MAY be a conductor, tires may get hot and burn.

2. With another person who is unable to free himself.

a. Shut off power if possible.
b. Stand on dry surface and use a dry stick or rope to free the victim. Make sure your hands are dry or wear rubber gloves.
c. Check victim for breathing and heartbeat and give cardiopulmonary resusitation if necessary and call doctor.

VI. Preventing Grain Bin Suffocation.

A. Causes. (Transparency 46)

1. Going inside bin with auger running.

a. Flowing grain acts like quicksand.
b. Takes only a few seconds to become helpless.

2. Bridged grain with hollow area underneath.

a. Weight of person breaks through.
b. Can be completely covered in seconds.

B. If you must go inside a bin, use a life line and have someone close by. (Transparency 47)

(CAUTION: If auger is running, lifeline may not provide adequate safety as suction from flowing grain may cause person to be pulled apart.)

Student Learning Activities:

1. Demonstrate the dangers of gasoline vapors. (Wear safety glasses.)

Materials needed:
a. Erlenmeyer flash, 250 cc.
b. Cork stopper for flask.
c. Drinking glass.
d. 1/2 inch of gasoline in flask (keep stoppered).
e. Book of matches.
f. Ashtray.
g. CO_2 or dry chemical fire extinguisher.

Procedure:
a. Drop lighted match in glass to show nothing is in it.
b. Lift up flask, shaking gasoline as you do.
c. Emphasize that by sight alone you cannot know the material in the flask is gasoline; it may be antifreeze, colored water, grape juice or some other liquid.
d. State that you will now pour some gasoline in the glass.
e. Remove cork, place top of flask over glass and slowly tip up, but do not pour any liquid into glass.
f. Stop tilting and replace cork, stating that someone appears frightened, so we better not continue the demonstration.
g. Quickly set flask down several feet from glass; light match and drop in glass. The vapors will flash.
h. Ask how many knew what was happening. Most will admit they didn't.
i. Repeat to emphasize; also pour some vapor in a person's cupped hands, an open dish, etc. Then light each. Only the glass will contain a combustible vapor.
j. Emphasize:

1. Substance expands as it vaporizes.
2. As container is opened, the vapor shoots out and up.
3. Vapor settles into low pockets because it is heavier than air.
4. A container of gasoline should only be opened in an area where vapors will disperse quickly without forming an explosive mixture (1.3 to 6.3% by volume).
5. Gasoline should always be carried or stored in a red safety container marked "gasoline." (It was put in glass here so it could be seen.)

(See pages 20-21 in Safe Operation of Agricultural Equipment, Instructor's Manual.)

2. Have students inspect their home and farm for fire hazards, location of fire extinguishers and heat and smoke detectors, and make a plan of an escape route from buildings.

3. Invite a representative from the Fire Department to demonstrate the correct use of fire extinguishers and discuss fire prevention.

4. Have students make a safety check of tractors and machinery at home.

5. Demonstrate with a model tractor how tractor overturns are caused.

6. Demonstrate how clothing can get caught in turning shafts using a small power hand drill and a piece of cloth.

7. Have students inspect chemical labels for warnings, types of poison, etc.

8. Have students make a safety check of power line hazards, and a farm map showing power line location. Students should also put up warning signs where appropriate.

9. Have students determine reaction time using one of the following methods.

   a. Hand clasp method:

      1. 10 persons form a circle.
      2. Face out.
      3. Each person grasp the back of the left hand of the person on his right.
      4. One person in the circle acts as timekeeper so his left hand is not held by the person to his left.
      5. All but the timekeeper close their eyes so they will not see movement.
      6. The timekeeper starts keeping time and then releases the hand he is holding. That person then immediately lets go of the hand he is holding.
      7. This continues to the last person who is to the left of the timekeeper. When he feels his left hand released, he touches the shoulder of the timekeeper.
      8. The timekeeper announces the time for the message to go around the circle.
      9. Since all were alert and waiting for the signal, multiply by 2 to get a true reaction time.
      10. Divide the total time by 10, which is the average reaction time of those in the circle.

      The reaction time usually averages 0.7 to 1.4 seconds. The average time for a man at his peak reaction age (age 18-25) is 3/4 second. At younger ages (14 to 18), girls usually react in less time than boys, but by age 20, men react more quickly than women.

   b. Grab the dollar bill:

      1. Straighten out a dollar bill.
      2. Hold it by one end.

3. Have a youth put his thumb and forefinger around the bill from one side so one finger is 1/2 inch from Washington's picture and the other finger is 1/2 inch from the other side.
4. Tell him to grab the bill when you let go.
5. Let go of the bill without warning.
6. If the youth catches the bill, he can react in less than 1/2 second.

c. Drop the dime:

1. Two persons sit on chairs facing each other.
2. One sits with his feet located about 18 inches apart.
3. The other holds a dime above his feet.
4. He drops the dime without warning.
5. If the first youth gets a foot under the dime, his reaction at each height is: 24 inches - 1/2 second; 30 inches - 3/4 second; 36 inches - 1 second.

10. Have students read units 1, 5, 7, 8, 9, and 10 of Safe Operation of Agricultural Equipment, Student Manual.

11. Show any of the following audio visual material:

North Dakota State Film Library, Division of Independent Study, State University Station, Fargo, North Dakota.

Agricultural Tractor Safety.	Film
Electrical Safety Around the Farm.	Film
Farm Implement Safety.	Film
Farm Petroleum Safety.	Film
Fire On the Farm.	Film
For the Rest of Your Life.	Film
Using Fire Extinguishers the Right Way.	Film

Creative Visual Services, Iowa Farm Bureau Federation, West Des Moines, Iowa.

Second Chance.	Film
Suffocation Hazards in Flowing Grain.	Slide Set

Farm Film Foundation, Washington, D.C.

Combine Safety.	Film
Farm Equipment Safety.	Film
Farm Tractor Safety.	Film
Forage Harvest Safety.	Film
Wagon Safety.	Film

Modern Talking Picture Service, Inc., St. Petersburg, Florida.

Target: You! Tractor Safety.	Film

Media Library, Agricultural Communication Department, North Dakota State University, Fargo, North Dakota.

Safe Operation of Agricultural Equipment Series, Units 1, 5, 7, 8, 9, and 10. Slide set

THE MOST HAZARDOUS OCCUPATIONS (U.S.)

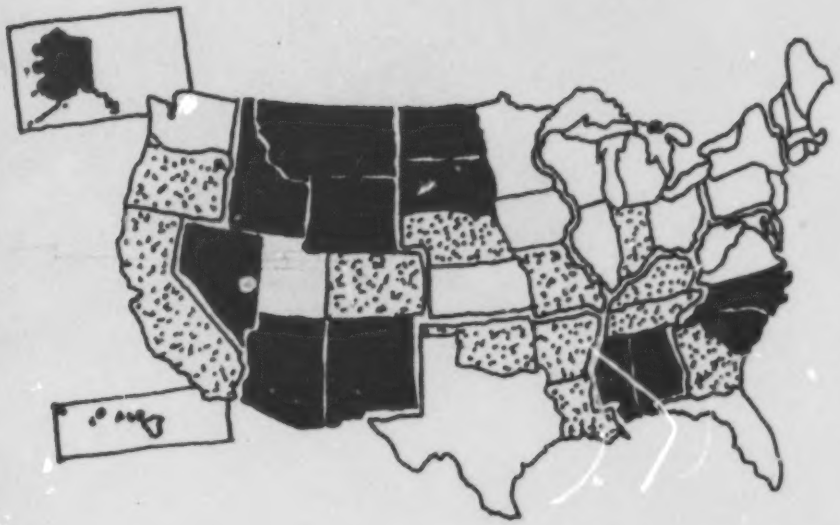
Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

INJURIES BY AGE AND SEVERITY

AGE	ALL INJURIES	SEVERITY				
		SLIGHT	SEVERE	PERMANENT	FATAL	UNKNOWN
ALL	100%	29.3	66.6	1.7	0.6	1.8
1-4	1.8	1.4	1.9	0.0	0.0	6.9
5-14	13.5	11.9	14.3	12.3	5.3	13.8
15-24	21.6	24.2	20.9	15.9	**31.6**	10.3
25-44	26.3	28.5	25.2	26.3	26.3	25.9
45-64	27.1	25.0	28.0	31.6	26.3	24.2
65+	4.8	4.7	4.5	12.3	10.3	8.6
UNKNOWN	4.9	4.3	5.2	1.7	0.0	10.3
TOTAL	100%	100%	100%	100%	100%	100%

Source: Farm/Ranch Standardized Accident Survey, An 18-State Report. National Safety Council, 1979.

ACCIDENT DEATH RATE IN UNITED STATES



LOWEST

MIDDLE

HIGHEST

81

A-9-2
TM 3

NORTH DAKOTA WORK ACCIDENT

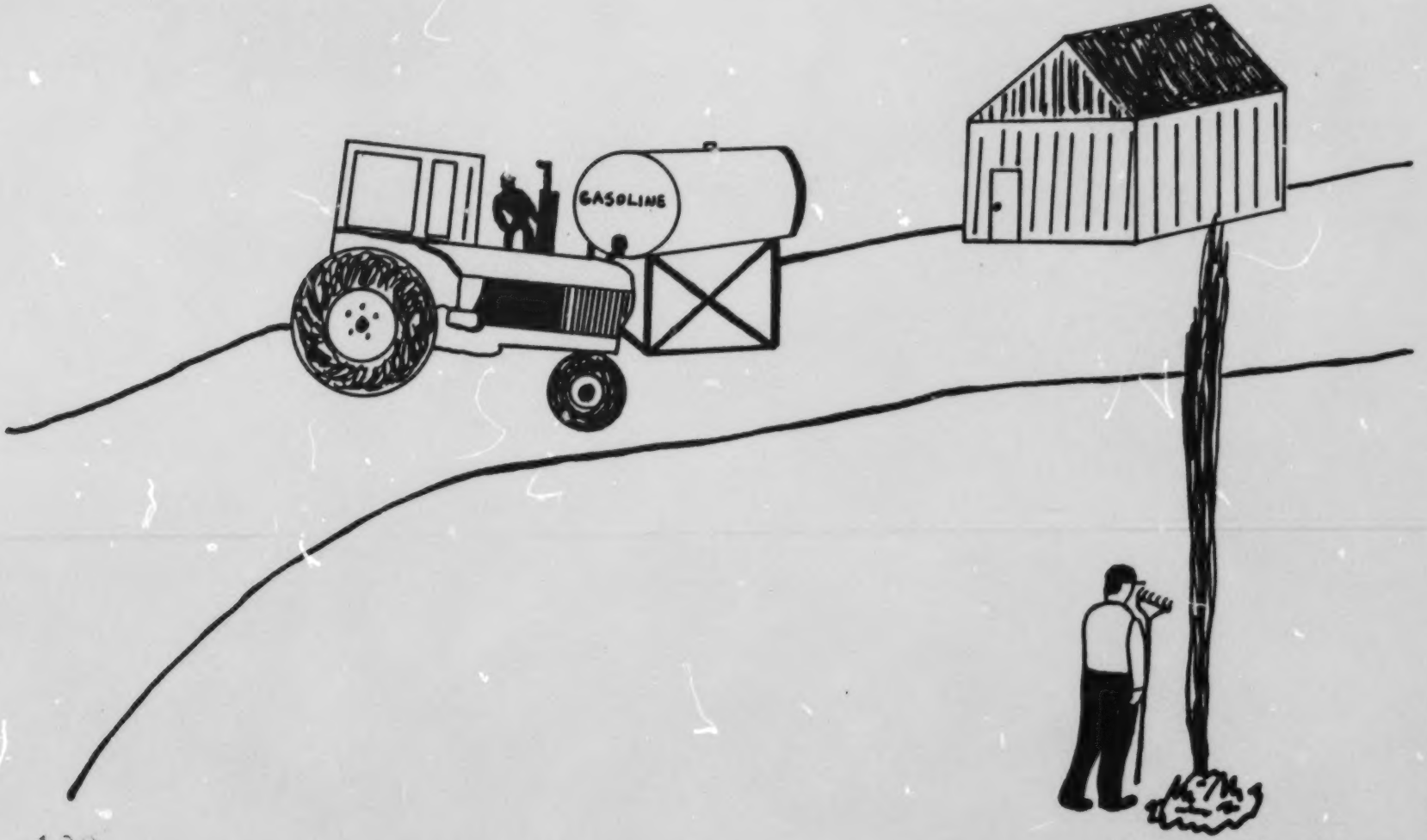
FATALITIES BY INDUSTRY
1965-1972

AGRICULTURE	**60%**
CONSTRUCTION	11%
SERVICE	8%
TRANSPORTATION	7%
MINING, OIL, AND GAS WELLS	4%
MANUFACTURING	3%
ALL OTHERS	7%

NORTH DAKOTA DEATHS DUE TO ACCIDENTS INVOLVING
TRACTORS OR SELF-PROPELLED MACHINERY
1965-1972

TRAFFIC	21%
TRAIN-TRACTOR	1%
MOTOR VEHICLE-TRACTOR	4%
TRACTOR RAN OFF HIGHWAY	**15%**
OTHER	1%
NONTRAFFIC	79%
PEDESTRIAN RUNOVER	13%
DRIVER/RIDER RUNOVER	**20%**
POWER TAKE OFF	4%
TRACTOR UPSET	**25%**
OTHER	17%

GASOLINE VAPORS CAN CARRY AS FAR AS 30 METERS (100 FEET) TO IGNITE.



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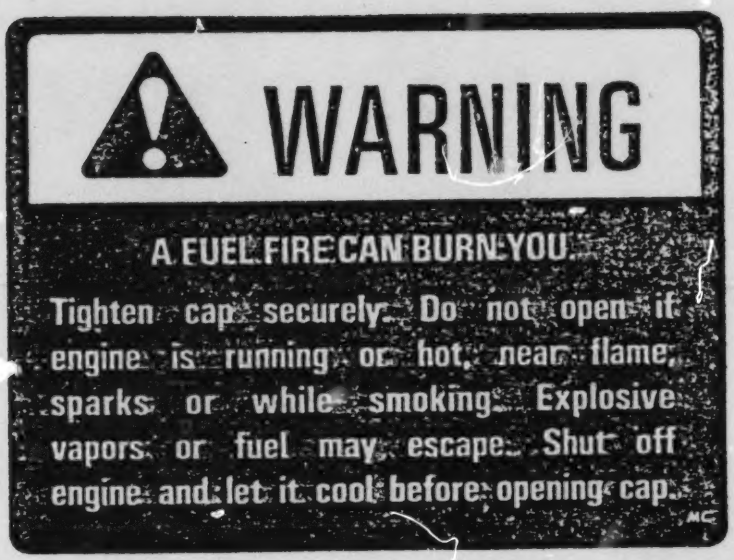
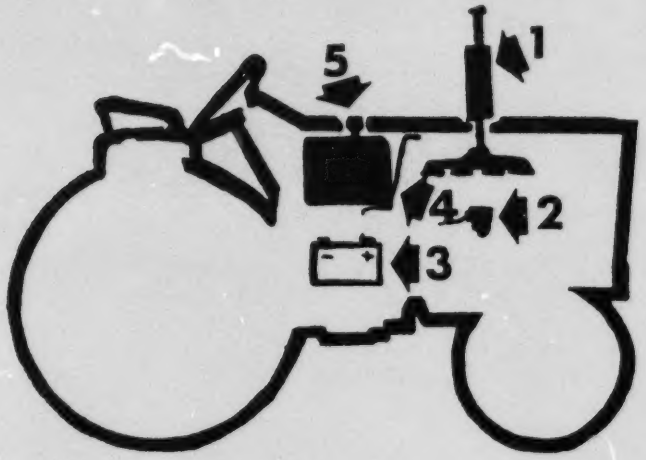

WARNING
A FUEL FIRE CAN BURN YOU
Tighten cap securely. Do not open if engine is running or hot, near flame, sparks or while smoking. Explosive vapors or fuel may escape. Shut off engine and let it cool before opening cap.

WARNING SIGN FOR FUEL TANKS AND VEHICLES

SAFETY CHECKLIST



1. Exhaust system
2. Fuel leaks
3. Electrical wiring & connections
4. Fuel tank heat shield
5. Fuel cap

Types of Fire Extinguishers

Pressurized Water

Soda-Acid

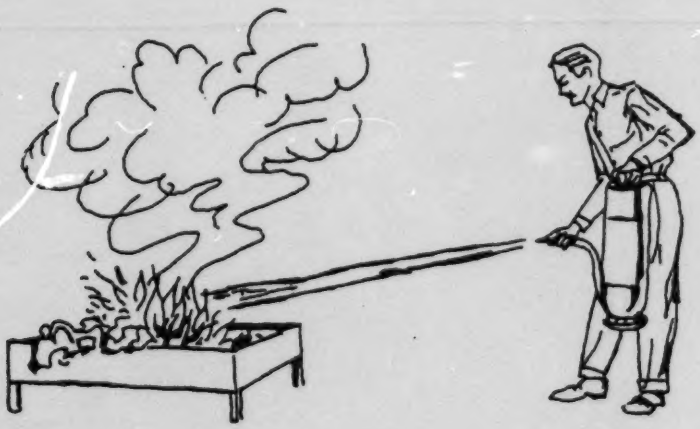
Carbon Dioxide

Dry Chemical

Foam

Courtesy of Oklahoma State Board of Vocational and Technical Education, Stillwater, Oklahoma

OPERATING A FOAM EXTINGUISHER



Turn upside down and let foam fall on fire with as little pressure as possible.

Courtesy of Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

OPERATING A CO_2 EXTINGUISHER

Stand close and aim at base of fire.

Courtesy of Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

IN CASE OF FIRE:

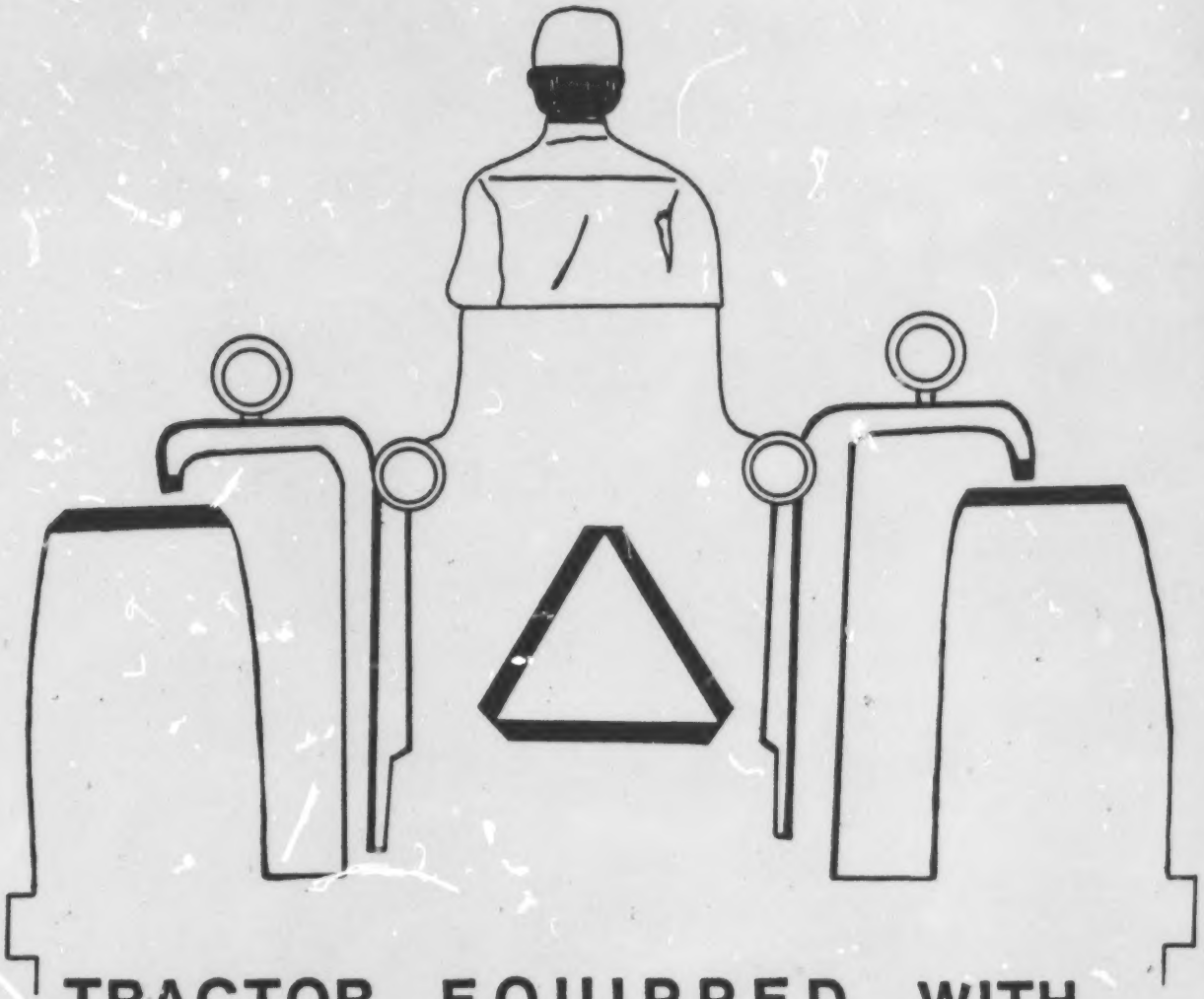
1. MAKE SURE EVERYONE IS OUT OF THE BUILDING.

2. SOUND THE FIRE ALARM.

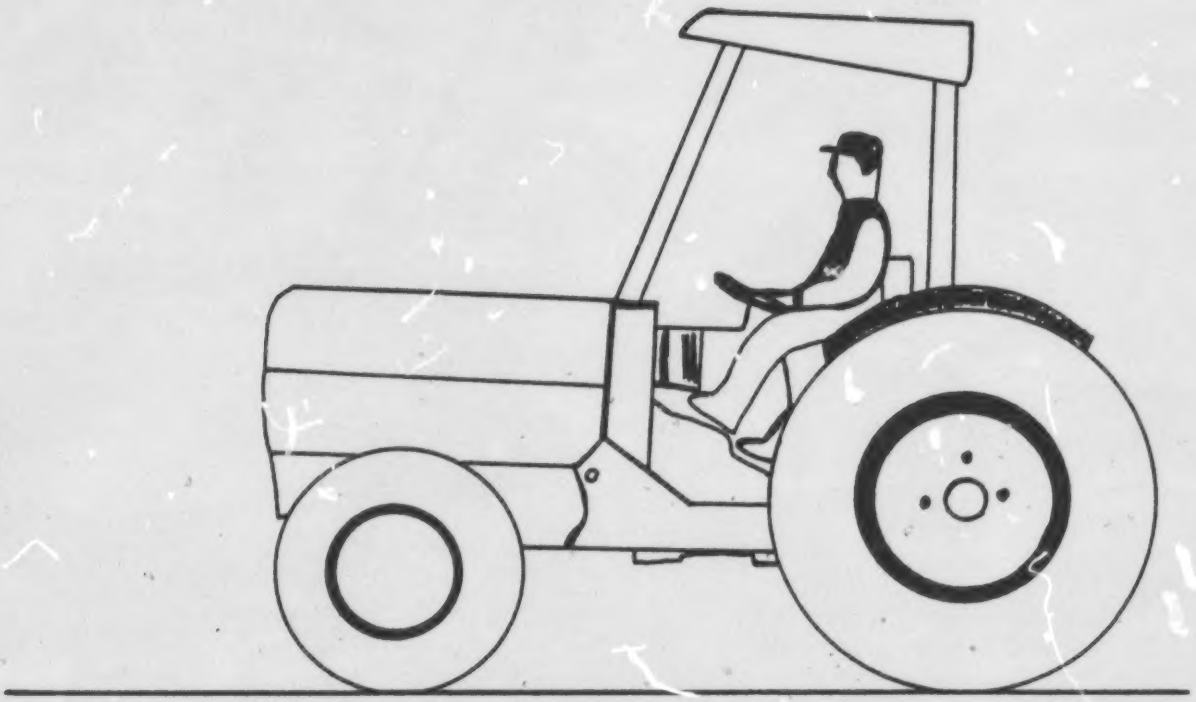
3. **THEN** FIGHT THE FIRE IF IT IS NOT OUT OF C

HE BUILDING.

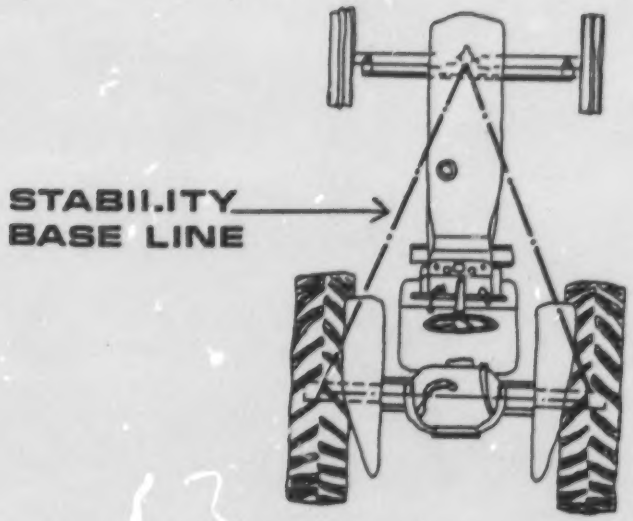
NOT OUT OF CONTROL.

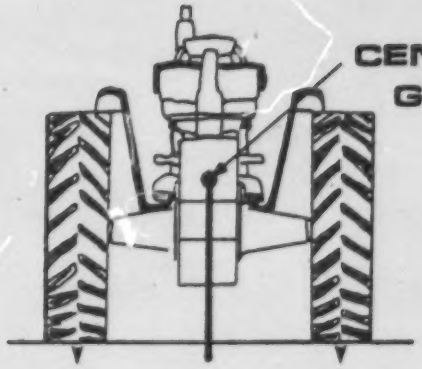


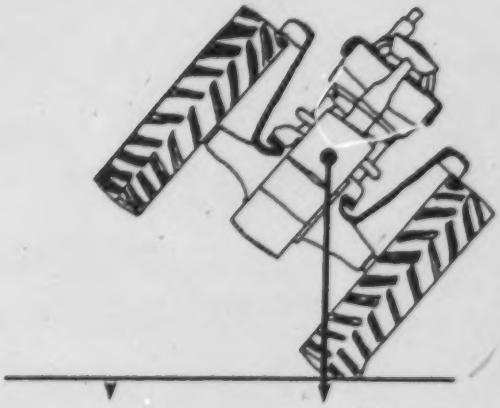
TRACTOR EQUIPPED WITH SLOW MOVING VEHICLE (SMV)EMBLEM

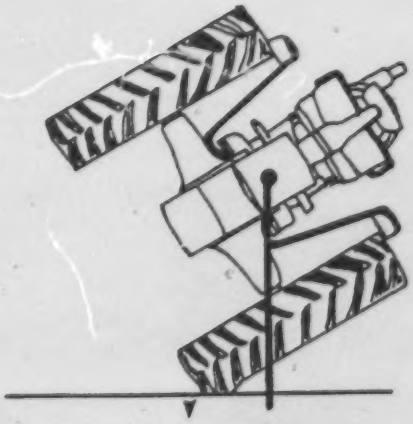


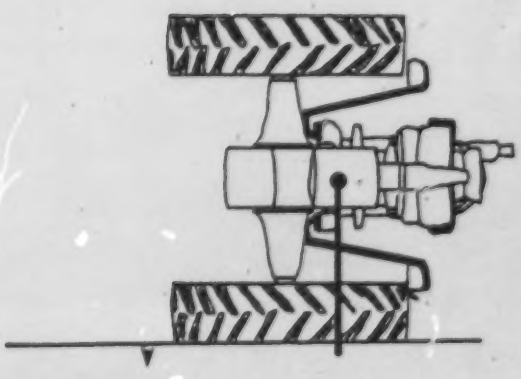
TRACTOR EQUIPPED WITH ROLL OVER PROTECTIVE STRUCTURE (ROPS)





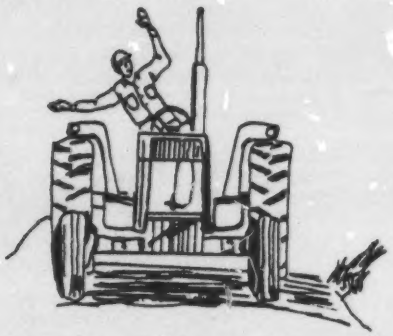




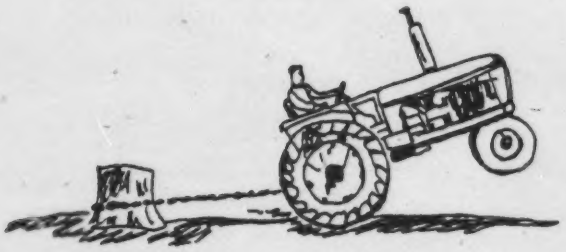


TRACTOR TIPS WHEN CENTER OF GRAVITY IS OUTSIDE STABILITY BASE LINE

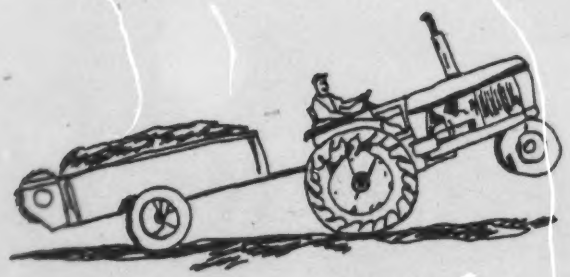
FORCES INCREASING OVERTURN



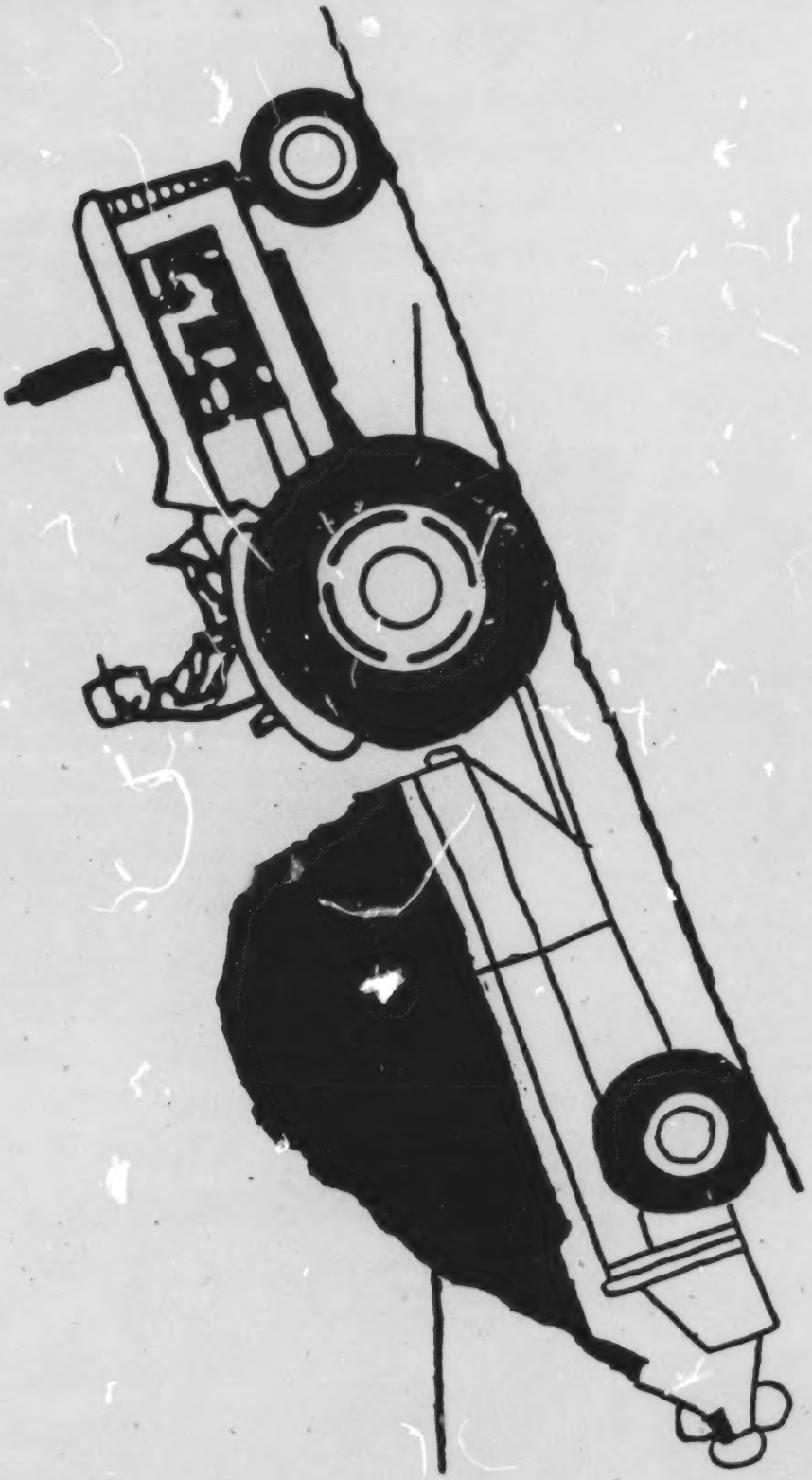
CENTRIFUGAL FORCE



REAR AXLE TORQUE



LEVERAGE FROM HIGH HITCH



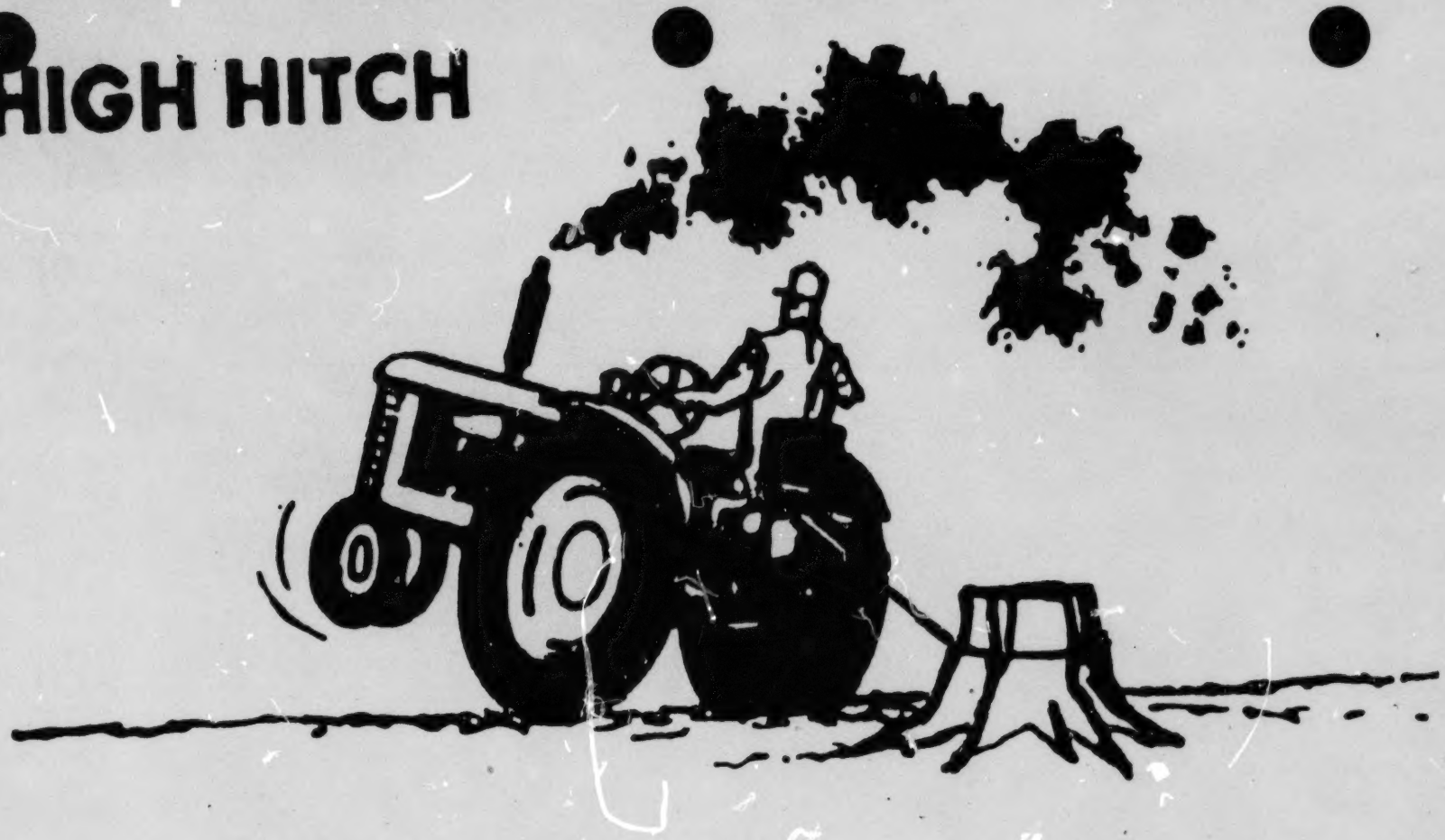
AVOID STEEP HILLS UNDER FULL LOAD

Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

When stuck, try to back out. Don't gun the motor and don't fasten post to rear wheel. Get help.

Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

HIGH HITCH



HITCH ONLY TO DRAWBAR OR REGULAR HITCH POINTS.
CHECK OPERATOR'S MANUAL FOR PROPER HEIGHT.

Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

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TM 19
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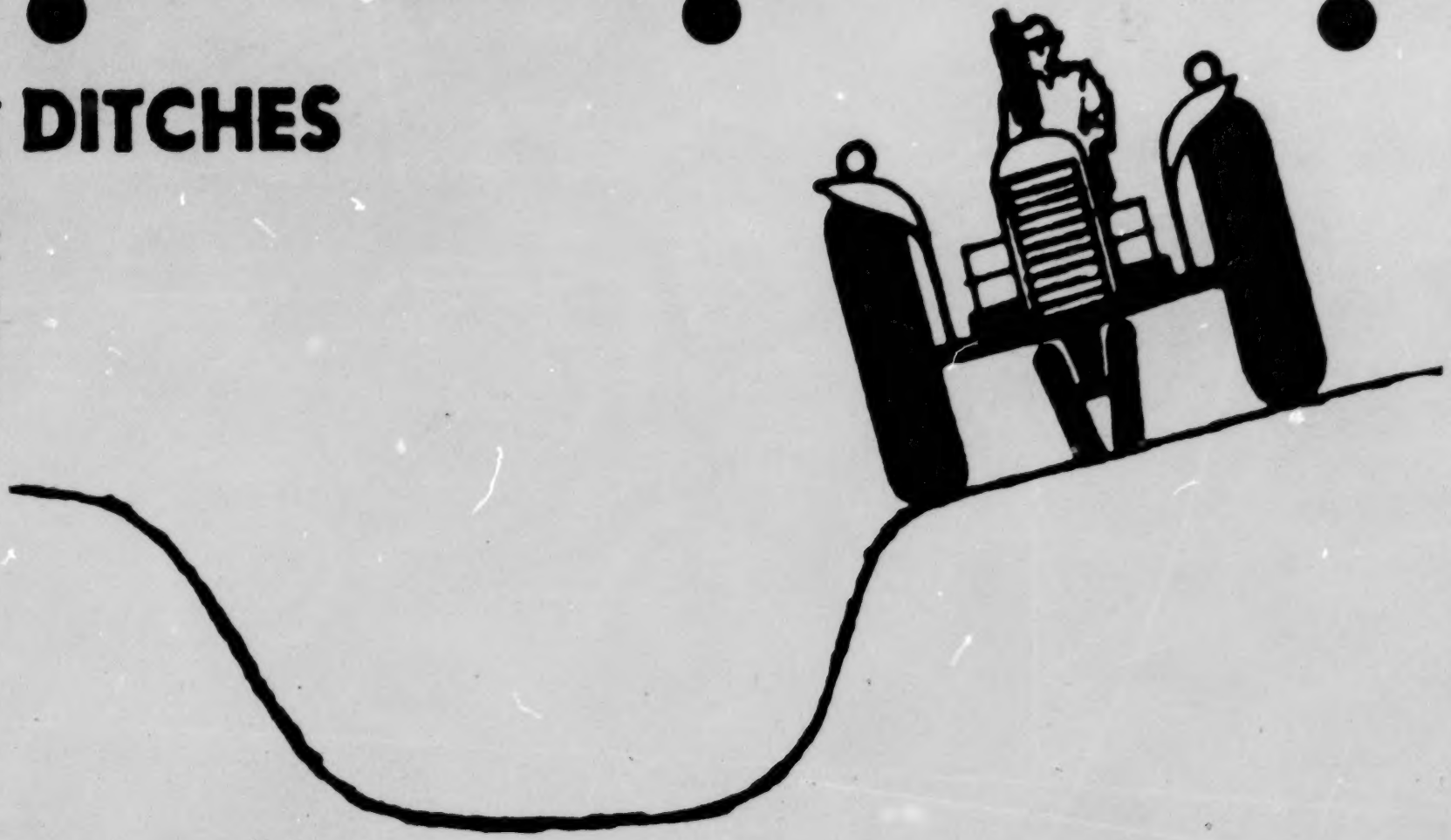
DITCHES



Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

Drive slowly when crossing or working along shallow ditches or grass waterways

CROSSING SLOPES

Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

Cross slopes slowly. Look-out for dips, raises, rocks, gullies, etc., that could trigger upset. Set wheels wide

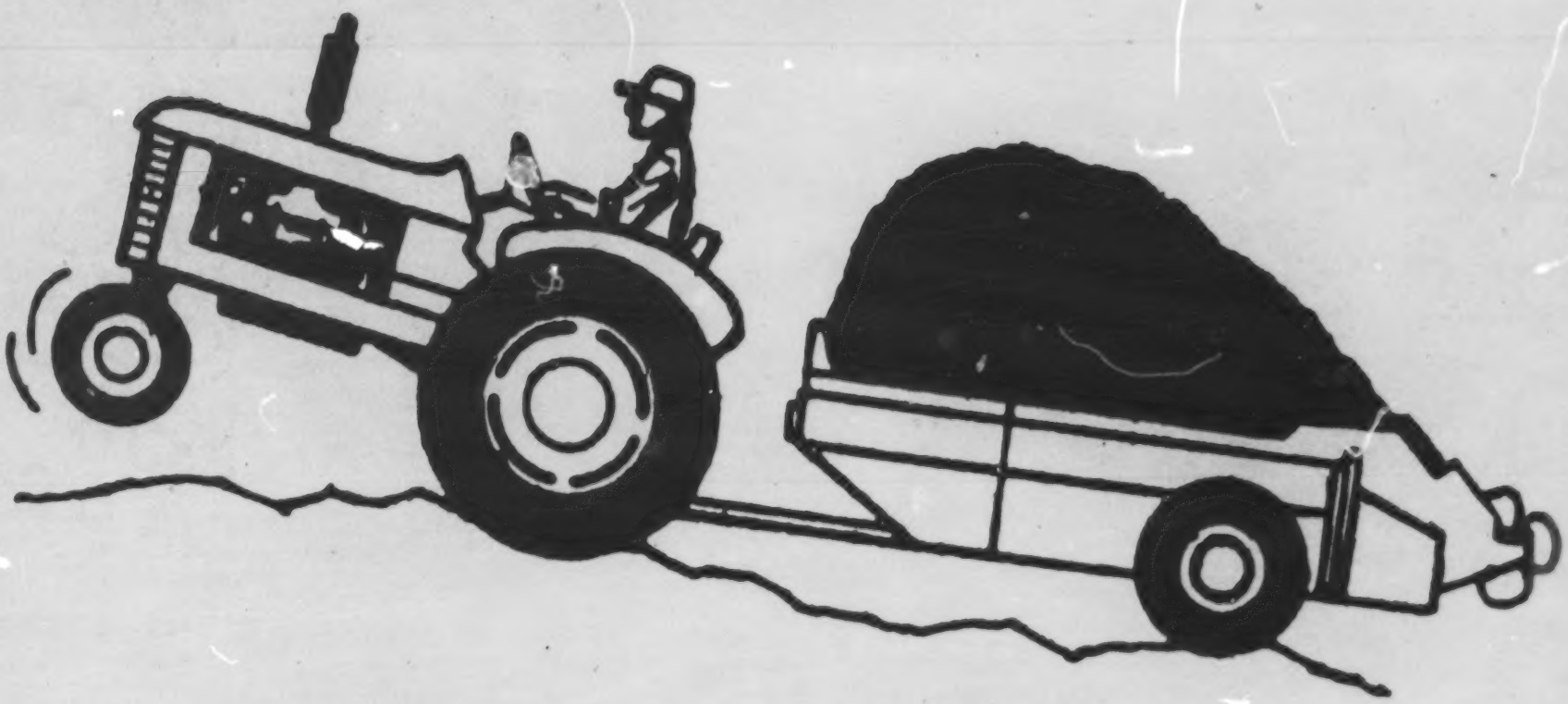
A-9-2
TM 21

MISUSE

Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

Use tractor for the jobs it's designed to do

LOADS ON DRAWBAR



ADD FRONT END WEIGHTS FOR BALANCE. HANDLE TRACTOR CAREFULLY ON SLOPES, WHEN CROSSING DITCHES, ON ROUGH GROUND, OR WITH MOUNTED IMPLEMENT.

Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

LOADS ON FRONT

Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

Operate front end loader according to instruction manual. Handle rig smoothly—avoid abrupt turns, jerky starts and stops.

SPEED

Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

Select safe speed for each job.
Slow down when turning.

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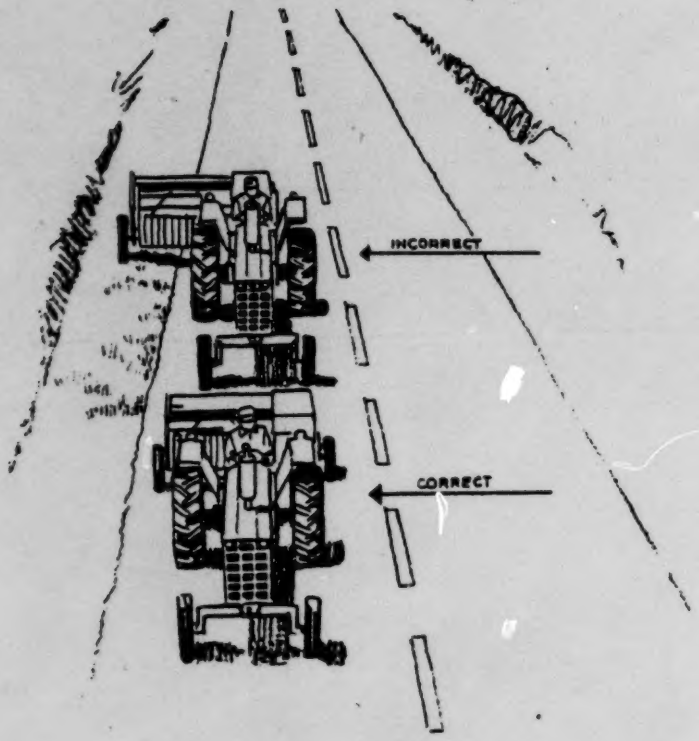
TM 25

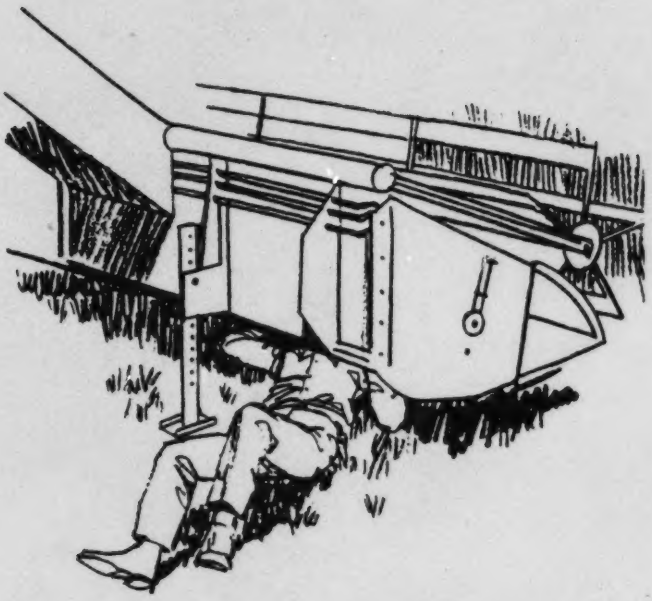
Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota

Use slow moving vehicle emblem on tractors and machinery.



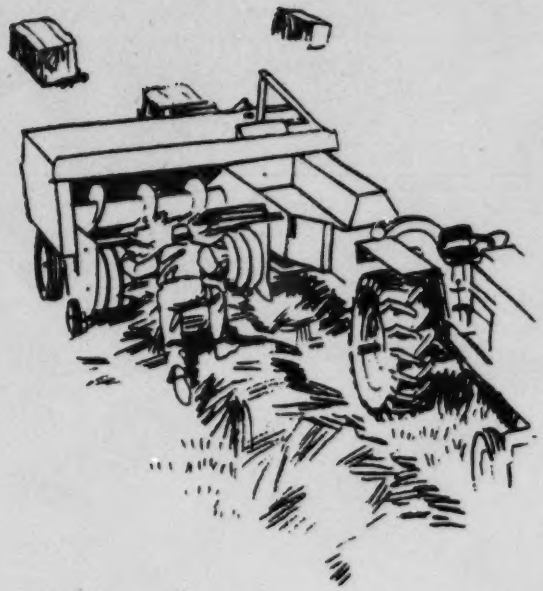
ALWAYS PLACE TRAILING MACHINE
IN TRANSPORT POSITION

Courtesy of International Harvestor Company.



DON'T RELY ON HYDRAULICS TO HOLD UP EQUIPMENT

Courtesy of International Harvestor Company.



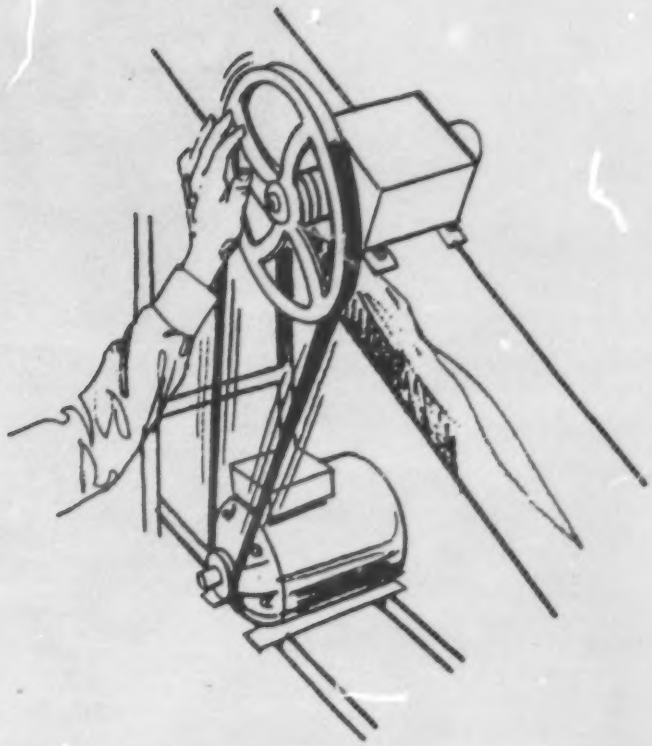
MAKE SURE ALL MACHINE PARTS HAVE STOPPED
BEFORE CLEANING OR ADJUSTING MACHINERY

Courtesy of International Harvestor Company.

Don't allow riders on

tractors or equipment.

Courtesy of Agricultural Communications Department, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota



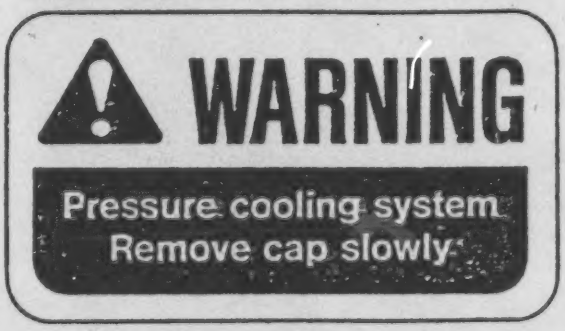
USE CAUTION AROUND ANY MOVING PARTS

Courtesy of International Harvestor Company.

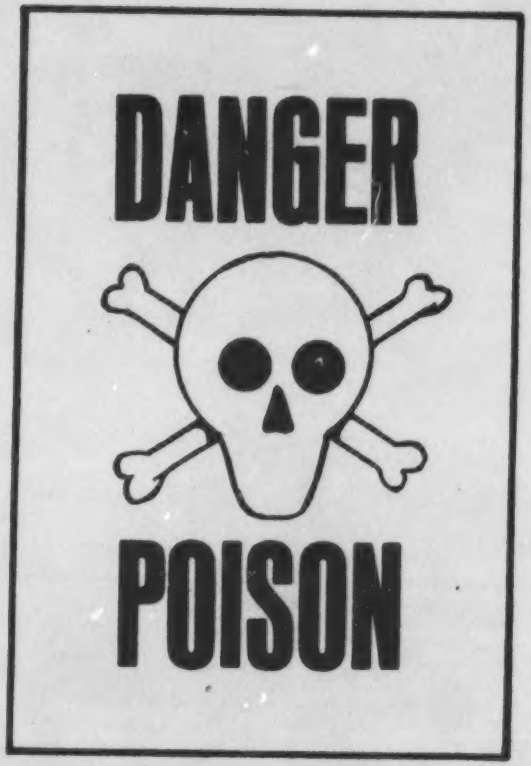
REACTION TIME IS TOO SLOW TO UNPLUG FEEDER WITH POWER SOURCE ON

SAFETY ALERT SYMBOLS

CAUTION
1. Keep all shields in place.
2. Make certain everyone is clear of machine before starting engines or operation.
3. Stop engine, lower implement to ground and shift to "PARK" before dismounting. Wait for all movement to stop before servicing machinery.
4. Keep hands, feet and clothing away from power driven parts.
5. Keep others off equipment unless observation seat or platform is provided.
6. Reduce speed when turning or applying individual brakes.
7. Couple brake pedals together for road travel and use flashing warning lights on highway unless prohibited by law.



Signal Words



Highly Toxic

Moderately Toxic

Slightly Toxic to
Relatively Nontoxic

Source: Principles Of Pesticide Use, Handling, And Application. Office of Pesticide Programs, Environmental Protection Agency. Courtesy of Ellis Associates, Inc., College Park, Maryland.

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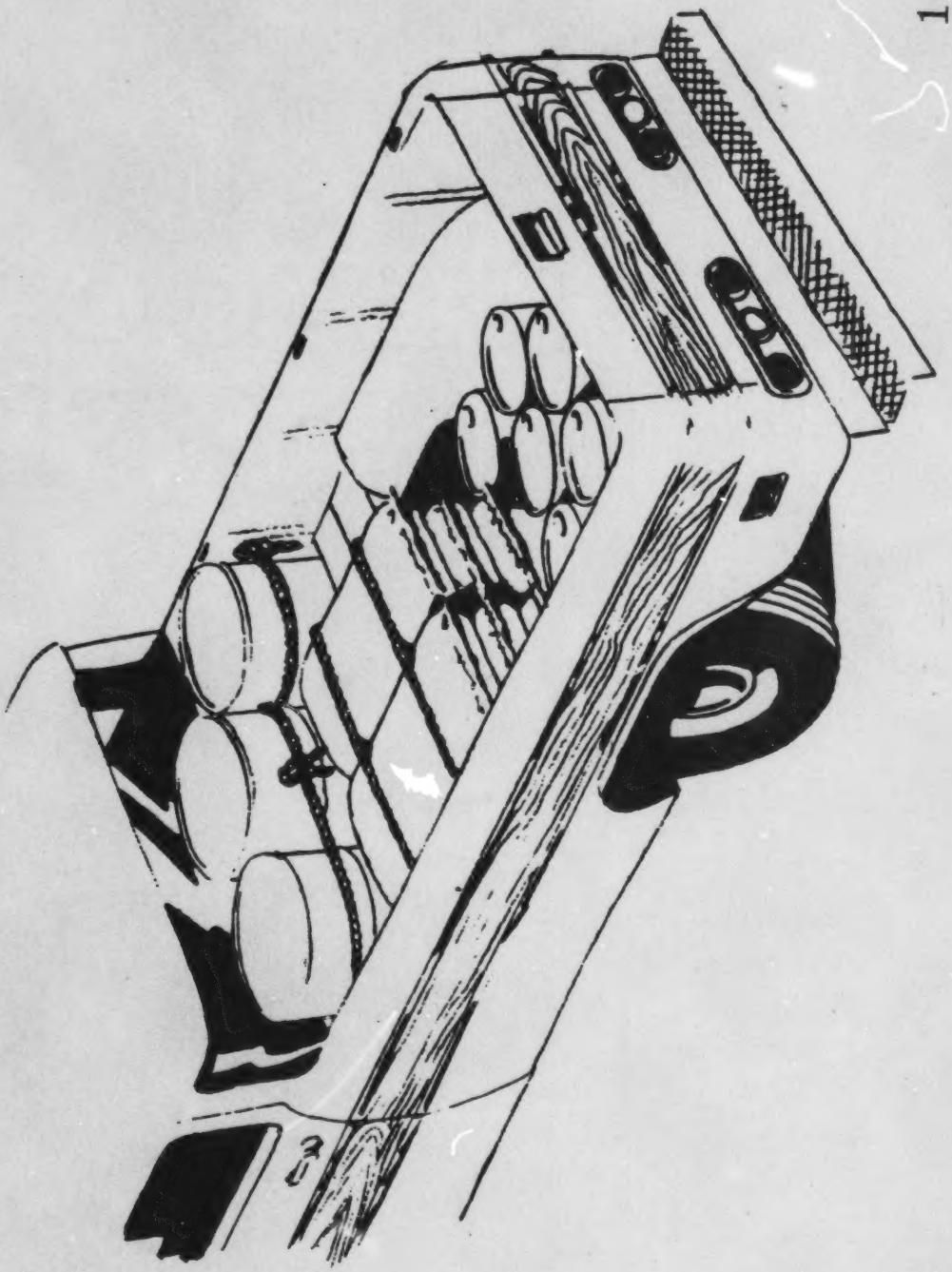
Securing Containers



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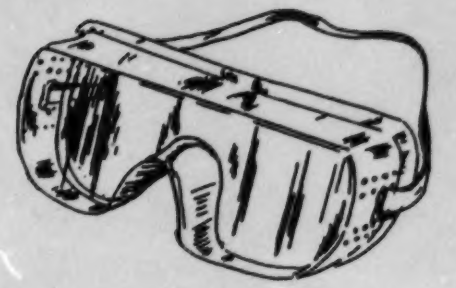
Source: Principles Of Pesticide Use, Handling, And Application. Office of Pesticide Programs, Environmental Protection Agency.
Courtesy of Ellis Associates, Inc., College Park, Maryland.

Protective Clothing and Equipment

Respirator

Long Rubber Gloves

Waterproof Hat



Goggles

Long Pants Over Boots

Rubber Boots

Source: Principles Of Pesticide Use, Handling, And Application. Office of Pesticide Programs, Environmental Protection Agency. Courtesy of Ellis Associates, Inc., College Park, Maryland.

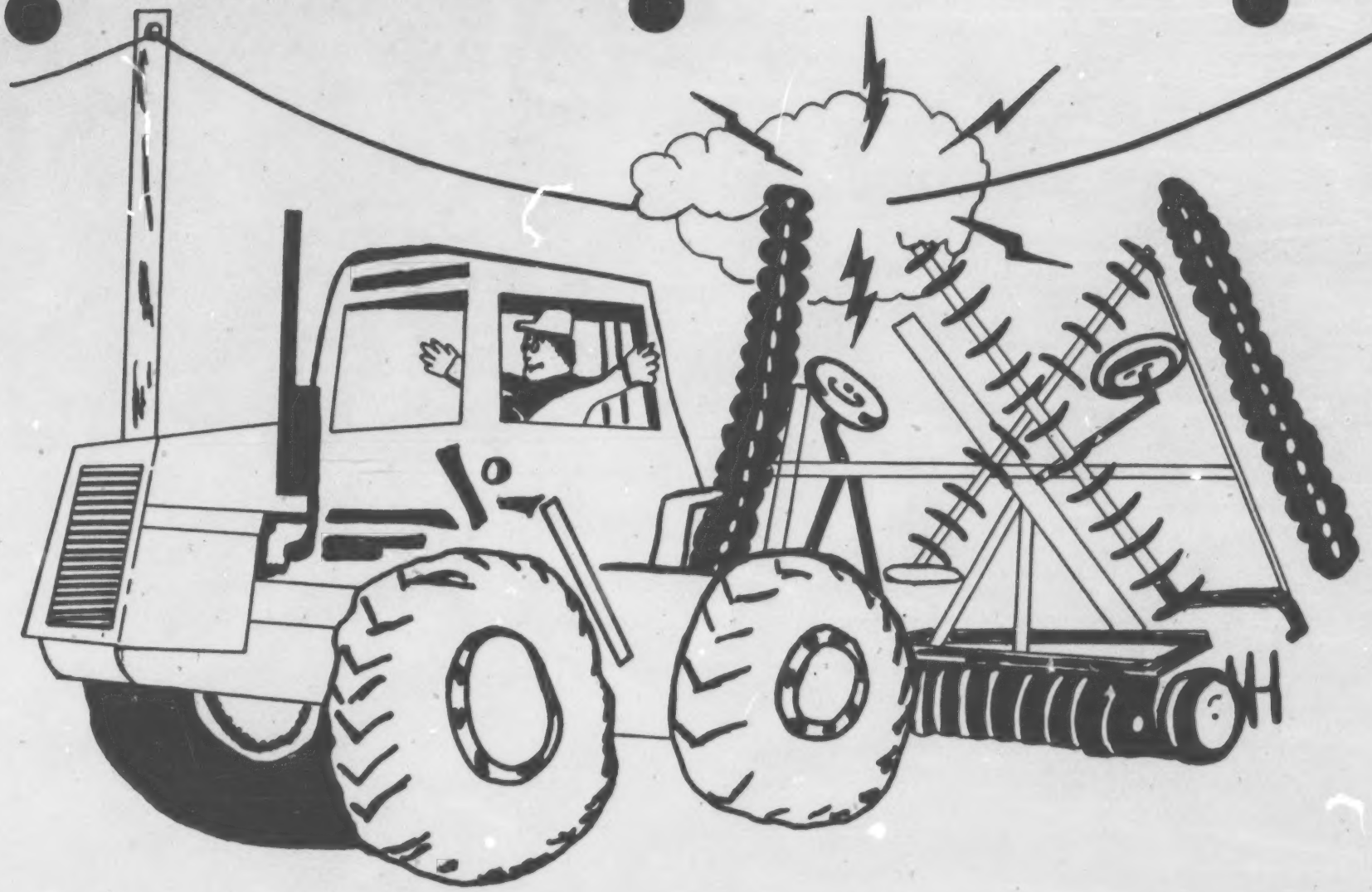
Proper Mixing

Source: Principles Of Pesticide Use, Handling, And Application. Office of Pesticide Programs, Environmental Protection Agency.
Courtesy of Ellis Associates, Inc., College Park, Maryland.

A-9-2
TM 38

PROTECTIVE GEAR FOR WORKING WITH ANHYDROUS AMMONIA

WEAR A SELF-CONTAINED BREATHING APPARATUS AND USE A SAFTY ROPE WHEN DANGER OF POISONOUS GAS EXISTS



USE CAUTION MOVING LARGE EQUIPMENT

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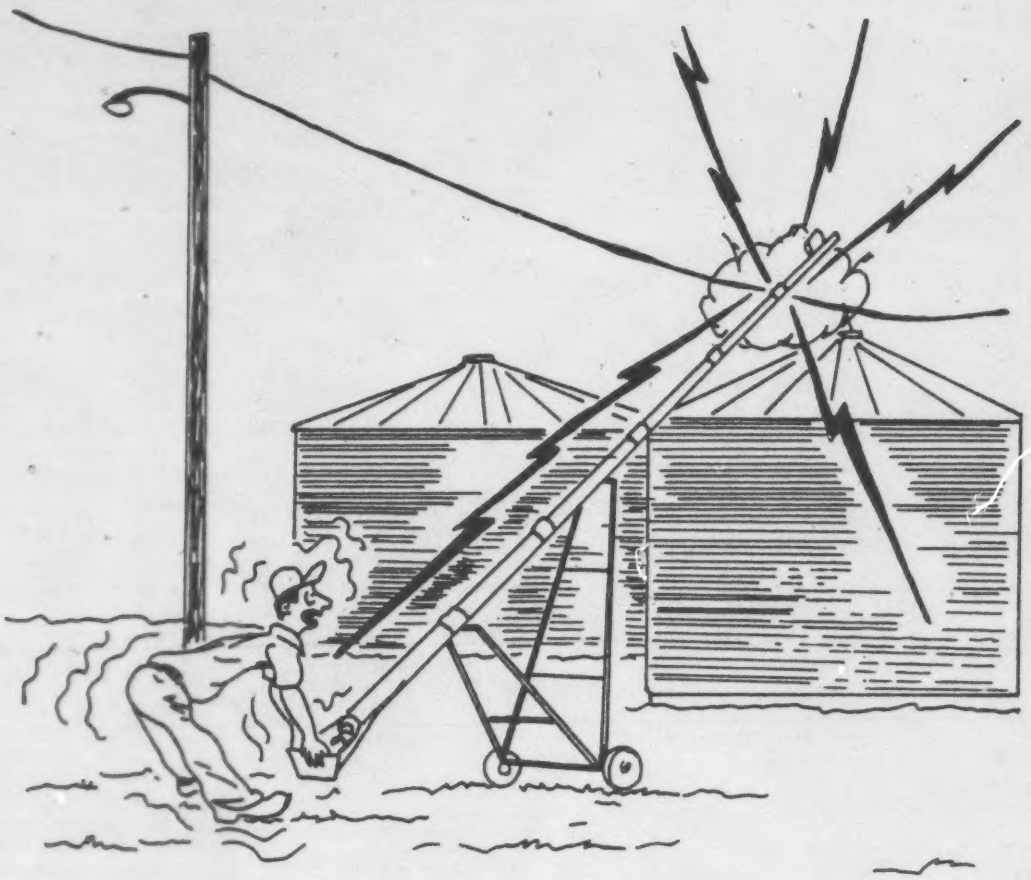
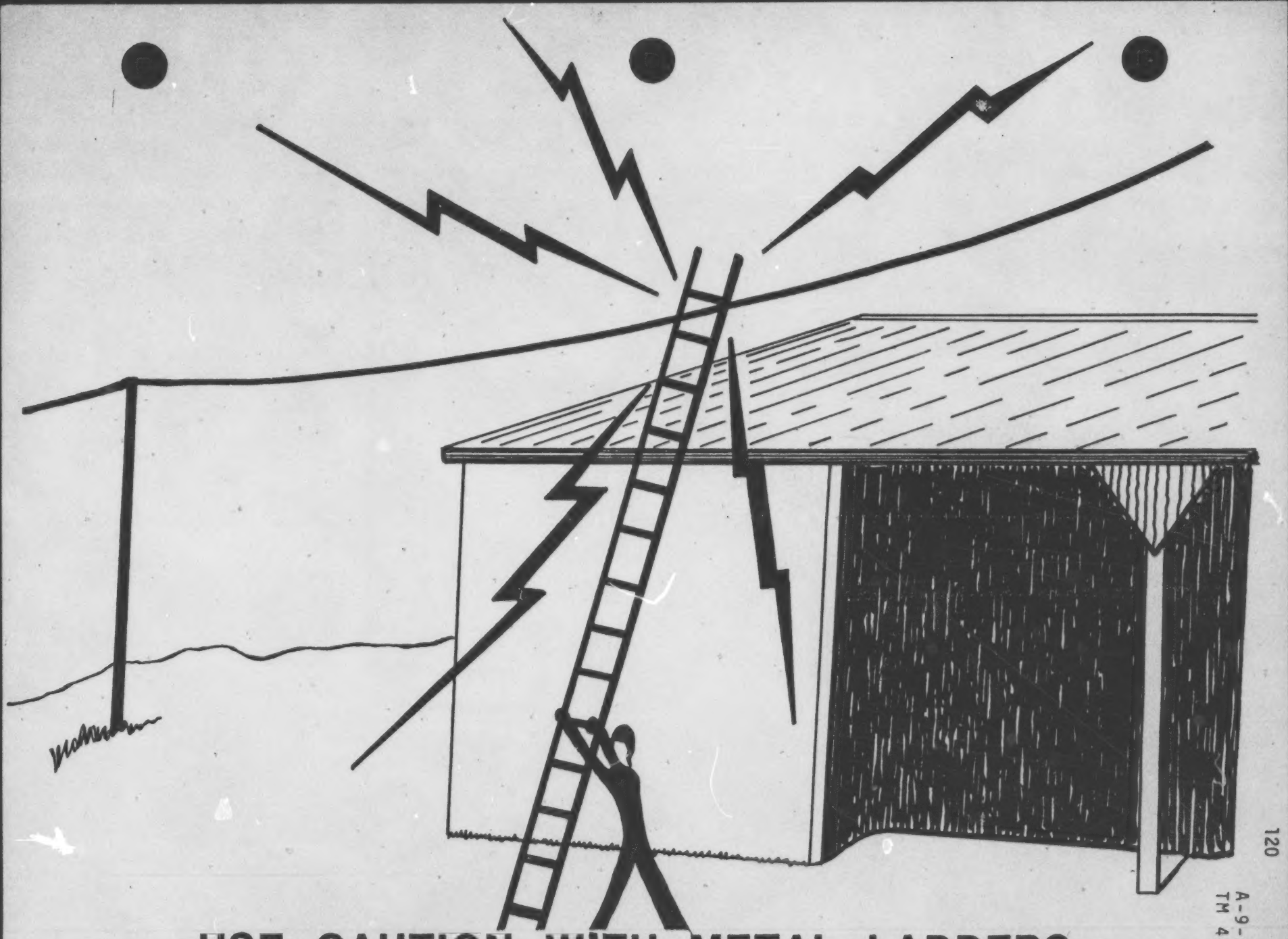
TM 40

Lower auger before transporting





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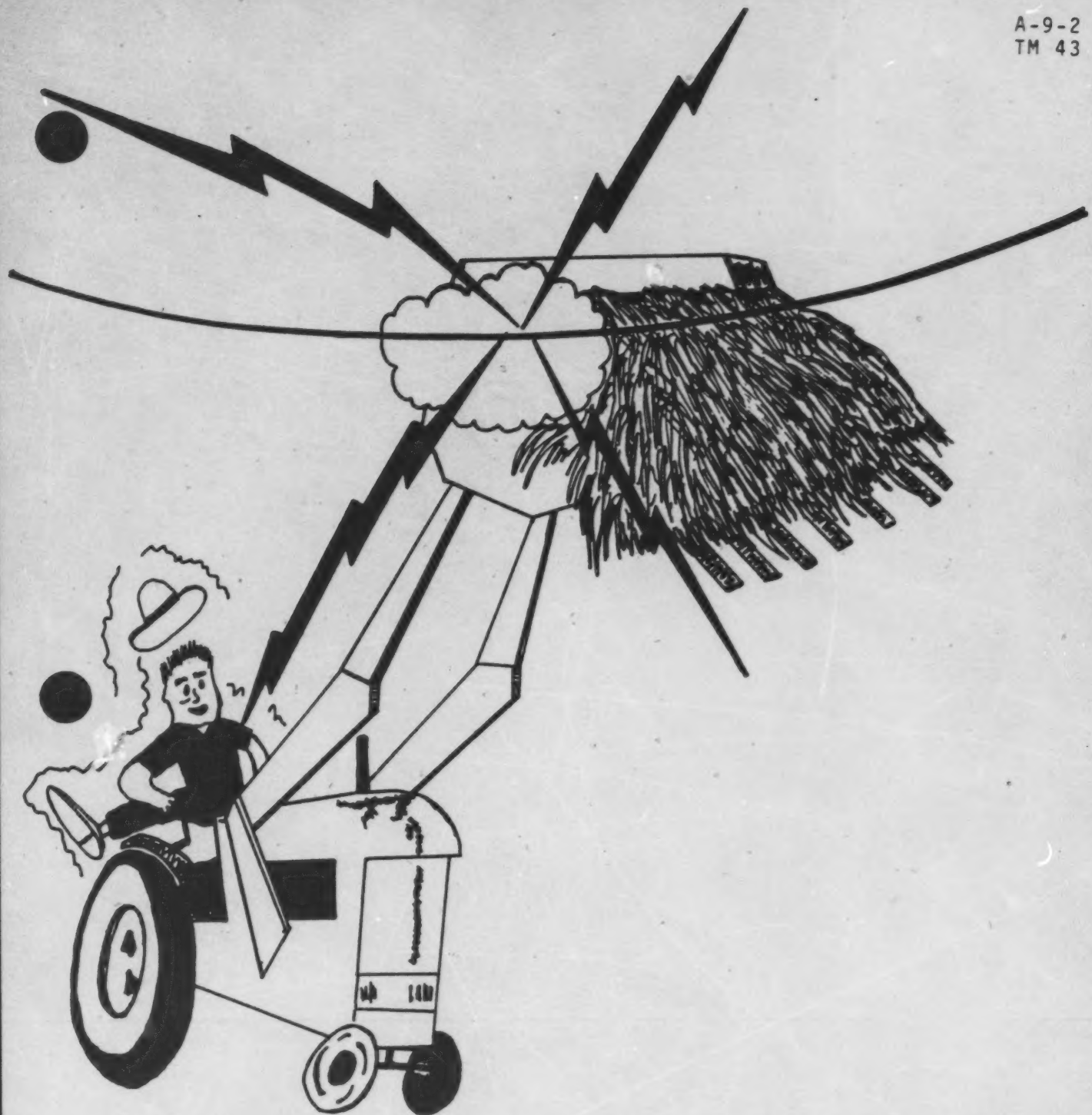
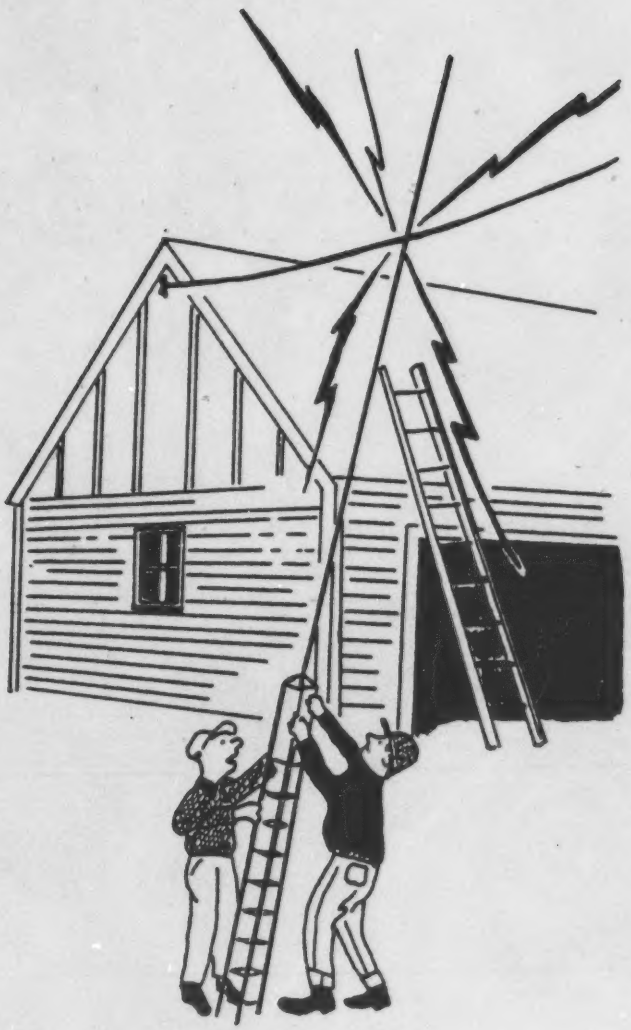
TM 43

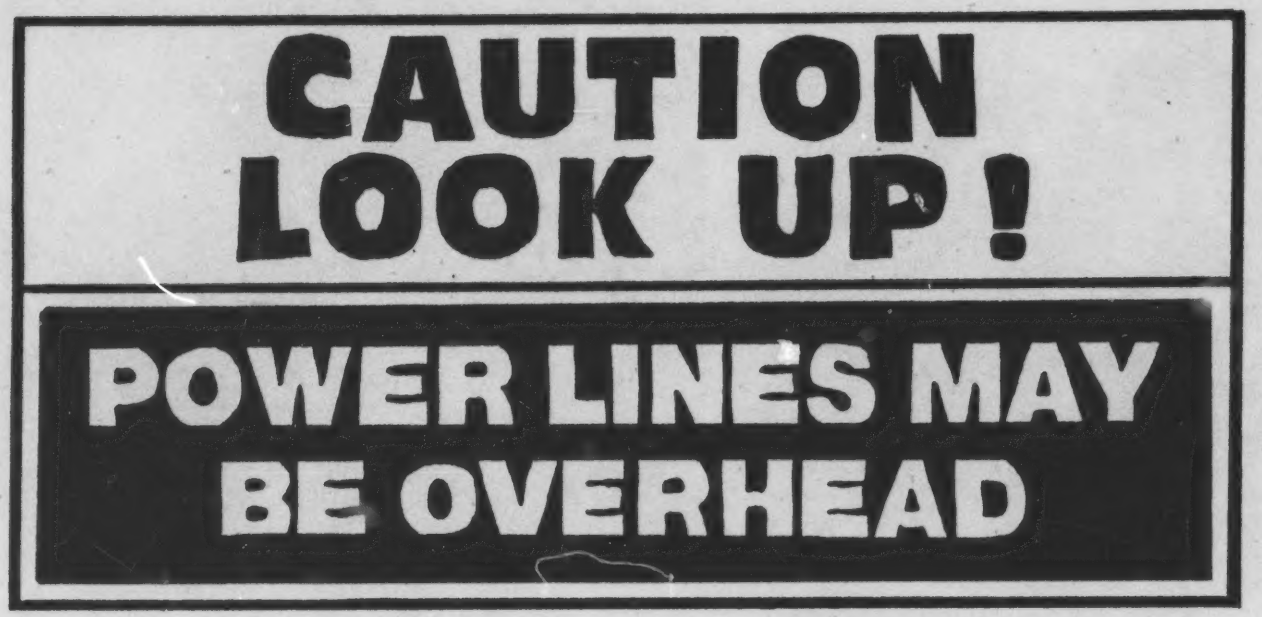


USE CAUTION WITH LOADER TRACTORS

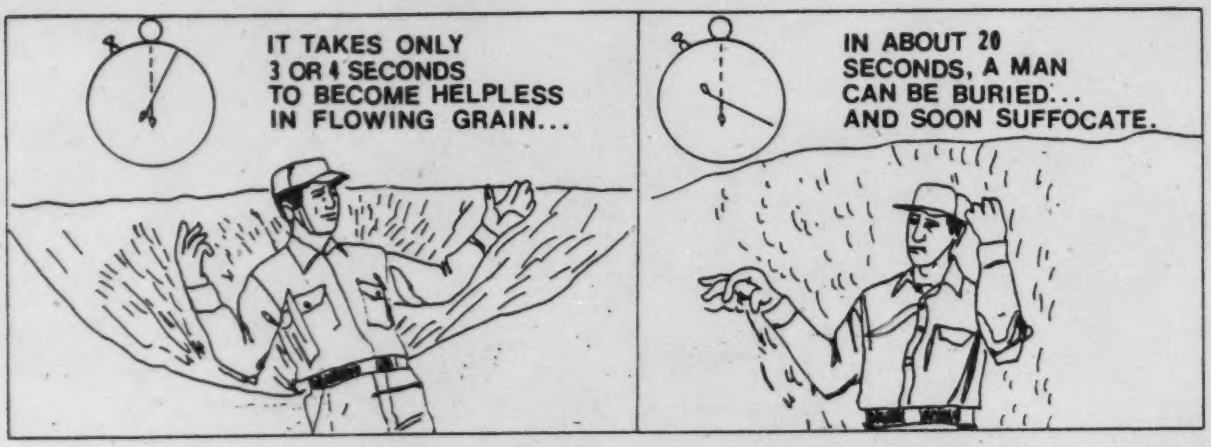
Place antennas away from power lines.

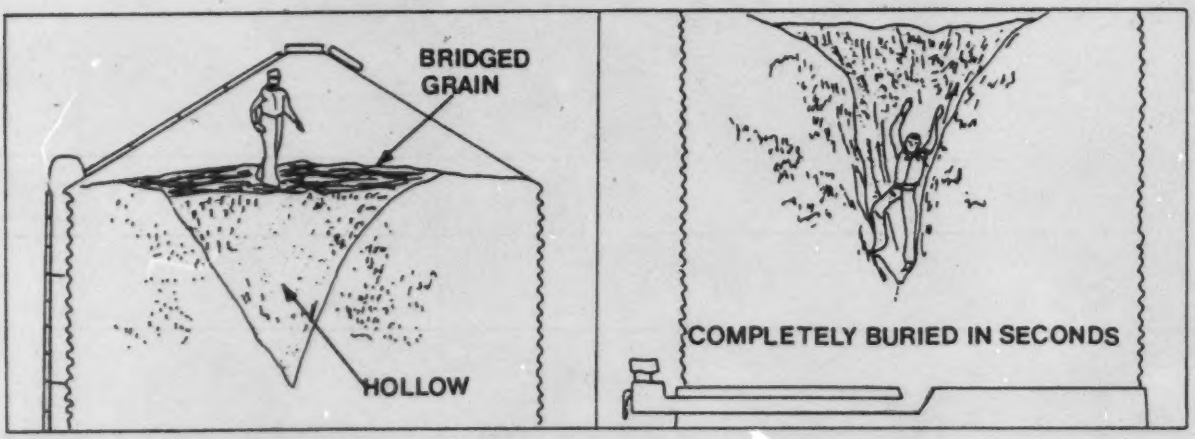


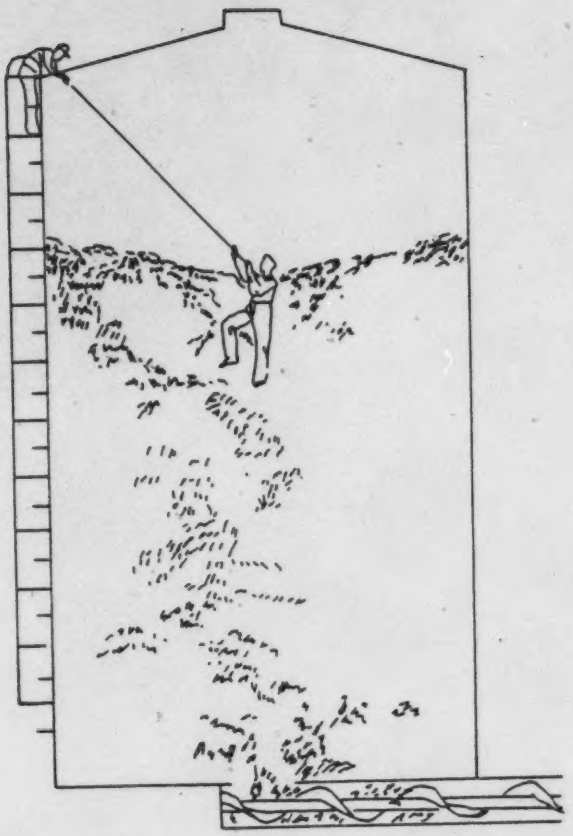
Place warning signs where appropriate



CAUSES
OF GRAIN BIN SUFFOCATION







If you must go inside the bin, use a life line.

Job 3: Operating A Tractor Safely.

Objectives:

The objectives of this job shall be met at a level predetermined by the instructor. The manner in which they are evaluated shall also be determined by the instructor.

Upon completion of this job, the student shall be able:

1. to locate and interpret gauges.
2. to react to gauges indicating faulty operation.
3. to locate and adjust controls.
4. to prepare the tractor and area for starting.
5. to start the engine.
6. to select the proper gear.
7. to drive a tractor.
8. to interpret hand signals.
9. to hitch implements.

Guide Questions:

1. What are the gauges and controls found on most tractors?
2. What is the proper procedure for starting an engine?
3. What are the proper procedures for driving a tractor?
4. What are the hand signals used to direct operators?
5. What is the proper procedure for hitching implements?

References:

Borgman, Donald E. et al. Fundamentals of Machine Operation - Tractors. John Deere Service Publications, Deere & Company, Moline, Illinois, 1974.

Gear Up...Throttle Down. Cooperative Extension Service, North Dakota State University, Fargo, North Dakota, January 1979.

Silletto, Thomas A. and Dale O. Hull. Safe Operation of Agricultural Equipment - Student Manual. St. Paul, Minnesota: Hobar Publications.

Tractor Operation and Daily Care. American Association For Vocational Instructional Material, Athens, Georgia, 1970.

Interest Approach:

Ask the students if they have ever seen the cockpit of an airplane or jet and what was it about the cockpit that they remember best. Most students will answer "controls, dials, gauges, etc." Then compare the cockpit of an airplane to the driver's seat of a tractor pointing out all the gauges and controls found on newer model tractors. Point out that although some may be confusing the operator's manual explains each one and should be consulted often.

Key Facts:

I. Gauges and Controls.

A. Instrument panel indicators. (Transparency 1)

1. Charge indicator.

a. May be a gauge or warning light.

b. Shows rate of charging or discharging of battery.

c. Discharge normally caused by a slow idle or heavy electrical load on battery.

d. If a continuous discharge is indicated, operator should stop and determine cause.

2. Coolant temperature indicator.

a. May be a gauge or warning light.

b. Shows temperature of engine cooling system.

c. Either too high or too low of a temperature may cause engine damage.

d. Some simple causes of overheating include:

1. Plugged radiator fins.

2. Broken fan belt.

3. Low coolant level.

4. Pulling too heavy of a load.

5. Broken radiator hose.

e. If excessive temperature is indicated:

1. Stop tractor but leave engine running to continue circulating coolant.

2. Inspect for worn or broken fan belt, plugged radiator fins, leaking or collapsed hoses.

3. If these are good, wait 4 or 5 minutes.

4. If temperature hasn't gone down, shut off engine and wait to cool, or if near water supply, run water over the radiator; then check coolant level.

5. Do not open radiator cap while still hot. Opening cap will release steam and cause serious burns.

6. If low on coolant, add very slowly. Cold water could cause cylinder head or block to crack if engine is warm.

7. Shifting to next lower gear will decrease pulling requirement.

3. Oil pressure indicator.

   a. May be a gauge or warning light.

   b. When starting, pressure will take a few seconds to build up.

   C. If indicator shows inadequate pressure, shut off engine immediately.

4. Tachometer.

   a. Shows speed of the engine in revolutions per minute (RPMs).

   b. May indicate ground speed also.

   c. Hour gauge located on same dial.

      1. Shows hours of use.

      2. Used in scheduling maintenance.

5. Fuel gauge.

   a. Shows amount of fuel left.

   b. Should never run out of fuel.

      1. Gasoline tractor will suck water and sediments from tank bottom into the line.

      2. Diesel tractors are difficult to restart.

3. LP gas is difficult to transport, requires special equipment.

6. Other.

a. Transmission oil temperature.

b. Transmission oil pressure.

c. Hydraulic oil filter.

d. Air filter.

B. Controls. (Transparency 2)

1. Seat adjustment.

a. Important so that all other controls are easily accessible.

b. When the horizontal adjustment is properly adjusted, with either the clutch or brake depressed, your leg should be straight and your back firmly against the back of the seat.

c. Height adjustment should allow you to see easily over the steering wheel and dash.

2. Steering wheel adjustment.

a. With both hands on steering wheel, elbow should be at 90° angle.

b. Allows greatest maneuverability and least fatigue.

3. On - off switch.

a. Turns on electrical power.

b. May or may not include starter switch.

4. Throttle.

a. Controls engine speed.

b. Need not be adjusted for varying load, governor automatically adjusts.

c. Fuel shut off switch may be included or separate.

5. Clutch.

a. Disengages transmission to stop tractor.

b. May be hand or foot operated.

6. Brakes.
   a. Separate for right and left wheels.
   b. Should be locked together when traveling on roads.
   c. Used separately to aid turning in field.
7. Transmission shift.
   a. Many different types.
   b. Gear selector.
      1. Found on all tractors.
      2. Selects desired forward or reverse gear.
   c. Range selector.
      1. Selects from two or more ranges of operating speed for the transmission.
      2. May be same lever as gear selector or different.
   d. High - low shifter.
      1. Variation of the range selector.
      2. Can be shifted while tractor is moving.
8. PTO controls.
   a. Transmission driven.
      1. Main clutch operates both forward speed and PTO shaft.
      2. Disengaging clutch will stop PTO.
   b. Continuous - running PTO.
      1. May have an auxilary clutch or a two stage clutch.
      2. Main clutch regulated both drive and PTO, but can also stop forward motion and leave PTO shaft turning.
   c. Independent PTO.
      1. Separate clutch for PTO.
      2. Most convenient and flexible.

9. Hydraulic controls.

    a. Three - point hitch.

        1. Position of lever determines height of lift arms.

        2. Most have an adjustable stop to set depth the same every time.

    b. Remote cylinders.

        1. Lever controls movement of cylinder arm.

        2. Depth control located on cylinder rather than lever.

        3. Control is different than three - point.

            a. Lever is either in extending, retracting or neutral position.

            b. Three - point hitch control is continuous.

    c. Hydraulic motors.

        1. Used to operate small motor or equipment.

        2. May have a reverse direction.

10. Ether assist.

    a. Used as an aid in starting diesel tractors in cold weather.

    b. Should be used according to instructions.

11. Glow plug.

    a. Used as an aid in starting diesel tractors in cold weather.

    b. Heats air in intake manifold.

12. Choke.

    a. Used as an aid in starting gasoline engines.

    b. Knob is returned gradually as engine warms up.

13. Other.

    a. Lights.

    b. Wipers.

    c. Turn signals.

C. Symbols for gauges and controls.

1. Indicators.

a. Two arrows pointing together indicate pressure.

b. Thermometer indicates temperature.

c. Drop indicates oil.

d. Waves indicate coolant.

e. Gear indicates transmission.

f. Circle with a small square attached on top indicates engine.

g. Dotted lines may indicate a filter.

h. Lightning bolt indicates electricity.

2. Symbols. (Transparency 3)

a. Engine oil pressure - engine symbol with oil drop and arrows.

b. Coolant temperature - circle with waves on top of thermometer.

c. Transmission oil pressure - gear with oil drop and arrows.

d. Transmission oil temperature - gear with oil drop and thermometer.

e. Change indicator - lightning bolt.

f. Engine RPM - engine symbol with piston and arrow showing movement.

g. Transmission oil filter - gear with two drops on either side of dotted line.

h. Air filter - rush of dirty air going through dotted line.

i. Fuel gauge - fuel pump.

j. Fuel shut-off - fuel pump crossed over.

k. Choke - closed butterfly in throttle.

l. Lights.

1. Parking - lamp with P.

2. Bright - lamp shining outward.

3. Dim - lamp shining downward.

4. Working - lamp angled downward.

II. Starting the tractor.

A. Preparing the tractor and surroundings.

1. Provide ventilation if inside a building.

2. Make a maintenance and safety check.

a. Fuel.

b. Oil.

c. Coolant.

d. Air filter.

e. Belts.

f. Tires.

g. Other (See Operator's Manual).

3. Adjust seat and fasten seat belt if ROPS equipped.

4. Make sure fuel supply is on.

5. Check controls for neutral position.

a. Gear shift in NEUTRAL or PARK.

b. PTO clutch.

c. Hydraulic levers.

6. Make sure persons are away from tractor and attached equipment.

B. Starting procedure.

1. Disengage clutch.

a. Safety precaution.

b. Makes starting easier.

2. Open throttle 1/3 to 1/2.

3. Turn switch to ON position.

4. Check to see that indicator lights come on.

5. Activate starter switch to crank engine.

a. Release starter switch when engine starts.

b. Do not crank for more than 30 seconds at a time.

c. Let starter motor cool and try again if engine doesn't start.

6. Starting gasoline engines.

a. Do not choke unless necessary.

1. Overchoking will flood the engine.

2. May cause damage to engine.

3. Puffs of black smoke in exhaust is indication of flooding.

4. Do not choke a warm engine.

b. If choking is necessary, pull knob out until engine starts and push back gradually as engine warms up.

7. Starting diesel engines.

a. Glow plug or ether assist used only in cold weather.

b. Turn glow plug on for about 30 seconds before cranking.

c. Use ether only in small amounts and only when engine is being cranked.

d. Check the operator's manual for correct procedure.

8. Starting LPG engines.

a. Open the vapor valve SLOWLY.

b. Crank engine.

c. Once started, open liquid withdrawal valve and close vapor valve.

9. After engine has started, check charge and oil pressure indicator.

10. Let engine warm up to operating temperature at a moderate speed, 800-1000 RPMs, before applying any load to the drawbar.

III. Driving a Tractor.

A. Selecting a gear.

1. Select a lower speed until you are familiar with the tractor and controls.

2. Should shift down before going uphill or downhill.

3. Should not overload engine.

   a. Thick black smoke indicates overload.

   b. Can determine if engine is overloaded by rapidly opening the throttle. If engine readily picks up speed, it is not overloaded. If it does not, shift down a gear or increase engine speed.

4. With light drawbar loads, select a higher gear and reduce engine RPM.

   a. Increases fuel efficiency 15 to 30 percent.

   b. Generally safe to reduce RPMs 20 to 30 percent of rated RPMs. Should check operator's manual.

   c. Drawbacks.

      1. Slower PTO speed.

      2. Slower reaction time with hydraulics.

B. Turning.

1. Use proper signaling.

2. Reduce speed considerably.

3. Make the turn gradually.

4. If pulling an implement, turn wide enough so implement stays on road and doesn't collide with rear tire.

5. May use brake on side of turn to make shorter turn at slow speed in the field. (Transparency 4)

C. Braking.

1. On the road.

   a. Keep brakes locked together.

   b. Apply gently but firmly.

   c. Reduce throttle speed and let the engine slow the tractor before using the brake.

   d. Make sure brakes are adjusted evenly to avoid being thrown to one side.

2. In the field.

   a. Used separately to make shorter turns, especially in soft ground.

   b. Depress the brake on the side in which you are turning.

D. On public roads.

1. Obey all traffic regulations.

2. Drive on shoulder of road but not off the road so far as to cause danger due to rocks, holes, etc.

3. Try to avoid heavily traveled roads.

4. If traffic collects behind you, pull over and let them pass.

IV. Operator's Hand Signals. (Transparency 5)

A. Start the engine - arm held down with elbow bent, fist moves in circular motion.

B. Stop the engine - elbow held out with open hand at chin moving back and forth.

C. Come to me / Come help me - open hand held over head moving in circular motion.

D. Move toward me / Follow me - elbow forward, open hand up moving front to back in a beckoning gesture.

E. Move out /Take off - open hand overhead moving from back to front.

F. Speed it up - elbow forward, moving fist up and down.

G. Slow it down - open hand held straight out moving arm up and down.

H. Raise equipment - pointing finger held overhead moving arm in circular motion.

I. Lower equipment - pointing finger held down, arm moving in circular motion.

J. This far to go - hands held apart indicating distance to go to back up to or drive up to something.

K. Stop - hand held up palm forward.

V. Hitching Implements.

A. Drawbar.

1. May be swinging or fixed.

a. Swinging allows easier hitching and turning but should be locked in place when hooked with PTO or traveling on the road.

b. Rollers should be lubricated periodically on swinging type.

2. Check operator's manual for proper drawbar height and adjust.

3. Length of drawbar may also be adjusted.

   a. Usually extended for PTO hookup. (Transparency 6)

   b. Retracted when using 3-point hitch.

4. Back up slowly to implement.

5. Align hitch holes by sight.

6. Place tractor in neutral and lock brakes.

7. If other person is hitching, use extreme care. Back tractor up before helper attempts to attach equipment, then drive forward to align holes. Keep hands away from hitch while tractor is moving.

8. Use a drawbar pin of adequate size to pull load. After pin is in place use a locking device to keep it from bouncing out.

9. Attach a safety chain on the road if available.

B. Three - point hitch.

1. Move drawbar forward or remove it.

2. Back up slowly to implement.

3. Align pin holes in draft arm with implement hitch pins.

4. Adjust draft arm height.

5. Place tractor in neutral and lock brakes.

6. Attach one draft arm and lock in place. Make sure pins fit snugly or hitch may be a different size.

7. Attach other draft arm (use length adjustment if equipped) and lock in place.

8. Attach upper link.

9. Some may have a quick coupler for easier hitching.

C. PTO.

1. Make sure drawbar is properly adjusted.

   a. Height may be different.

   b. Length should extend well beyond the PTO shaft.

2. Make sure PTO shafts are alike. (Transparency 7)

   a. 540 rpm shaft has 6 splines.

   b. 1000 rpm shaft has 21 splines.

   c. Cannot be hooked together although some tractors may be equipped for either.

   d. Also a larger 1000 rpm shaft for heavier loads.

3. Make sure telescoping arm on implement is in phase. (Transparency 8)

   a. U-joints should be facing same direction.

   b. If not, implement will run at irregular speeds when turning corners.

4. Slide connector onto shaft.

5. Attach locking device.

   a. Spring loaded pin.

   b. Bolt and nut tightener.

   c. Pin or bolt through the shaft.

6. Check locking device by pulling on connection.

7. Make sure all guards are in place and shaft shield turns freely.

D. Hydraulics.

1. Mount cylinder on implement if not already mounted.

2. Turn off tractor engine and relieve pressure in lines by holding lever forward and then back.

3. Remove dust plugs from couplings.

4. Clean the connections with a clean lint-free cloth.

5. Make sure connections are of the same manufacturer.

6. Attach connections.

   a. If equipped with a locking lever, release lock, insert cylinder end and lock in place.

   b. If it does not have a lever, pull the tractor end of hose toward the connection, insert cylinder end and push forward.

7. Check hose connection to make sure it is locked in place.

8. Attach hose to implement so it doesn't hang on ground and has enough slack for turning. Do NOT attach it to the tractor, if implement should become unhooked, couplings made to unhook automatically.

Student Learning Activities:

1. Have students identify gauges and controls on various tractors.

2. Have students go through procedure to follow if warning indicators show a problem.

3. Have students practice adjusting seat.

4. Have students start, and drive a tractor. A short course can be set up containing turns and some short backing. See pages 44-47 of Safe Operation of Agricultural Equipment - Instructor's Manual.

5. Hand out enclosed worksheet on hand signals. Also have students operate a tractor according to your hand signals.

6. Have the students hitch various types of equipment.

7. Have students read units 2,4,6, and 7 in Safe Operation of Agricultural Equipment - Student Manual.

8. Show slide/tape program, Safe Operation of Agricultural Equipment, Units 2 - Instruments and Controls, 4 - Starting and Stopping Tractors, 6 - Tractor Hitches, PTO and Hydraulics, and 7 - Tractor Safety on the Road.

Identify these operator hand signals in the blank provided.

_____

_____

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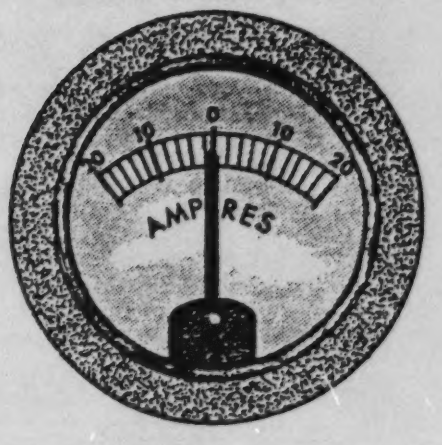
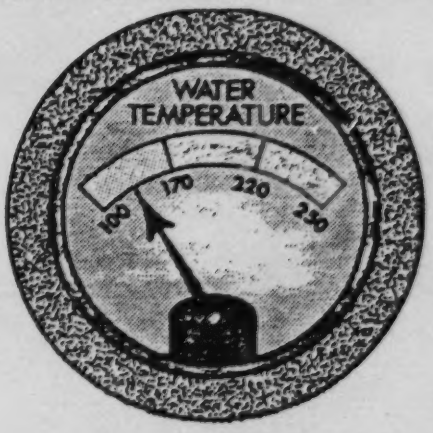
GAUGES TO AID IN OPERATION

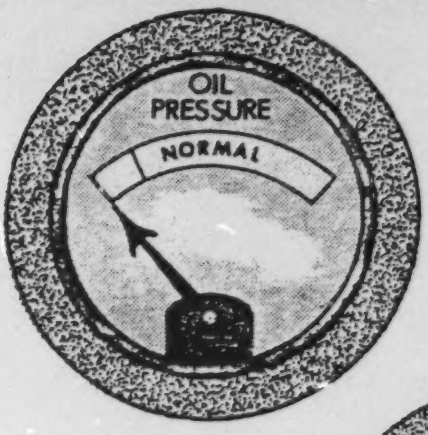
AMPERES GAUGE



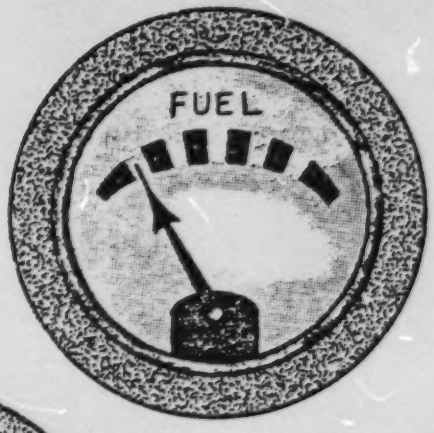
WATER TEMPERATURE GAUGE

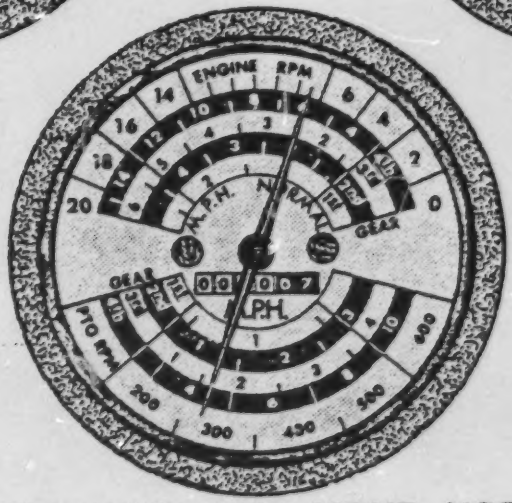


OIL PRESSURE GAUGE



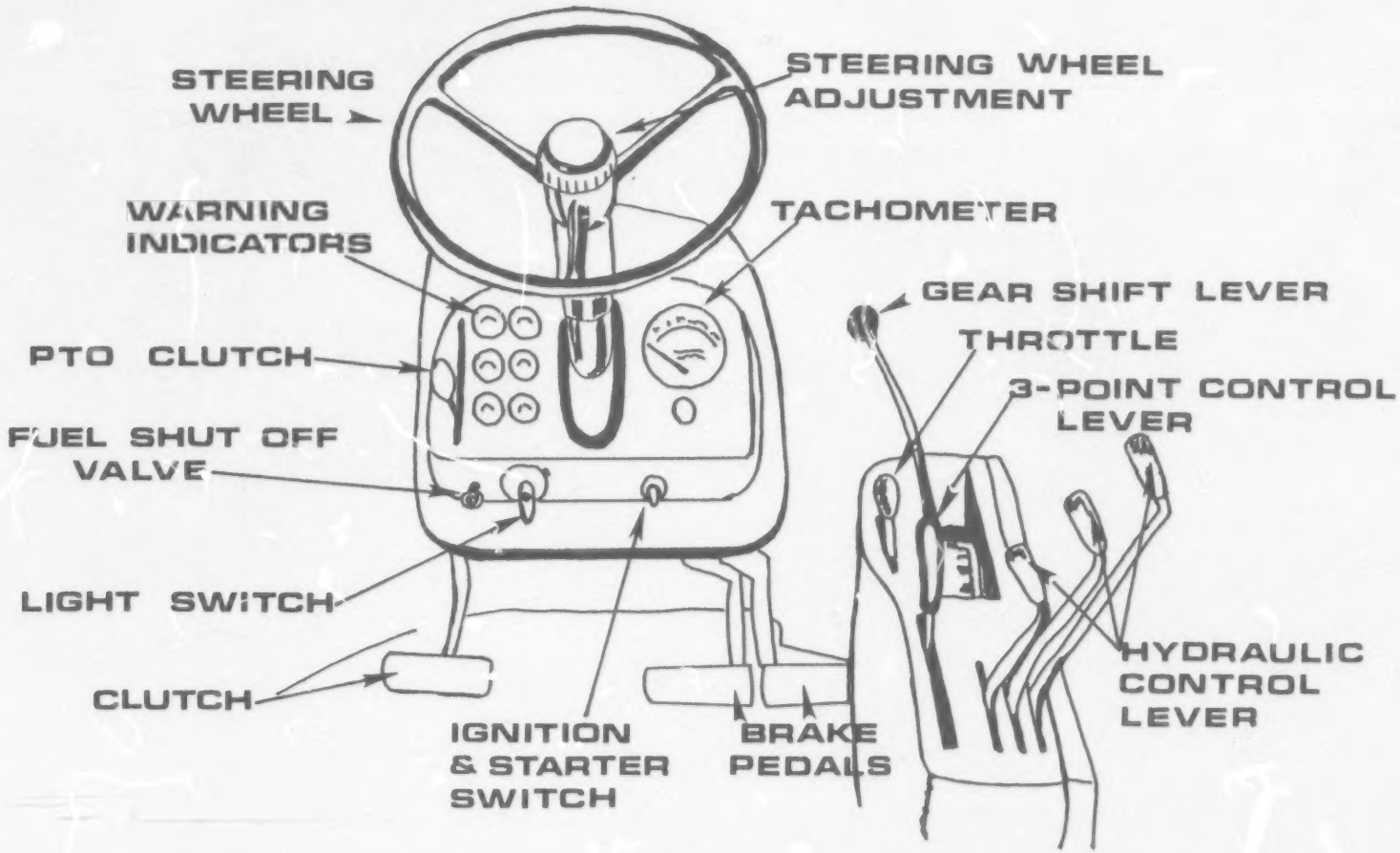
FUEL GAUGE





MILES PER HOUR AND HOUR USE GAUGE

Courtesy of Vocational Instructional Services, Texas A&M University, College Station, Texas



142

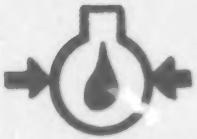
177

TYPICAL TRACTOR CONTROLS

178

A-9-3
TM 2

GAUGE AND CONTROL SYMBOLS



ENGINE OIL PRESSURE

COOLANT TEMPERATURE

TRANSMISSION OIL PRESSURE

TRANSMISSION OIL TEMPERATURE

CHARGE INDICATOR

ENGINE RPM

TRANSMISSION OIL FILTER

AIR FILTER

FUEL GAUGE

FUEL SHUT-OFF

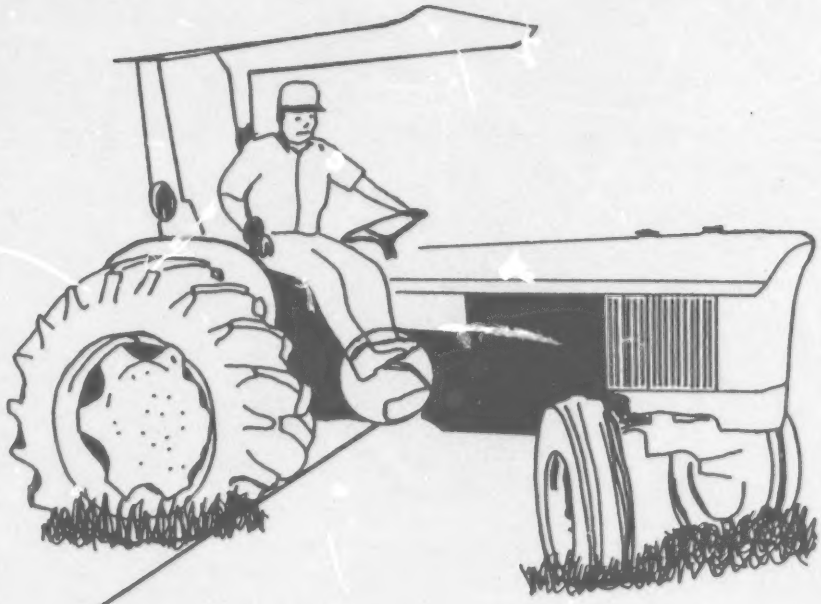
CHOKE

PARKING LIGHTS

BRIGHT

DIM

WORK



Braking in direction of turn will make shorter turn.

OPERATOR'S HAND SIGNALS

Start the engine.

Stop the engine.

Come to me/Come help me.

Move toward me/Follow me.

Move out/ Take off.

Speed it up.

Slow it down.

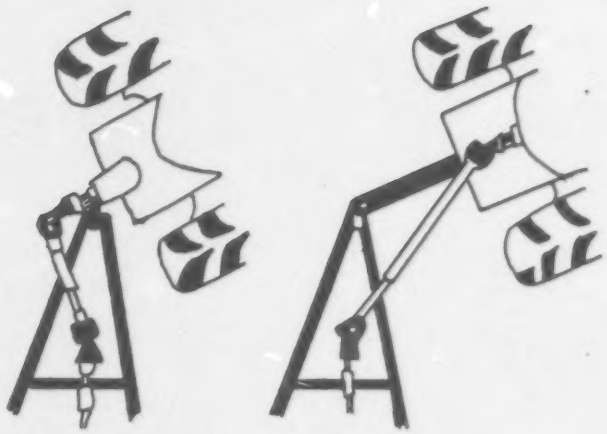
Raise equipment.

Lower equipment.

This far to go.

Stop.

Courtesy of Crops And Soils Magazine, Madison, Wisconsin. Copyright 1979 by the American Society of Agronomy, Inc.

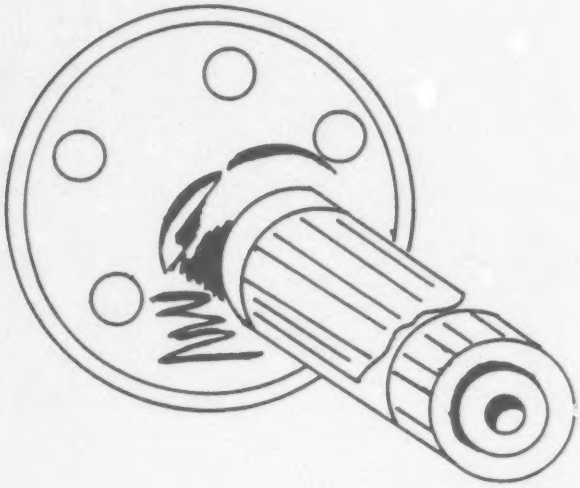


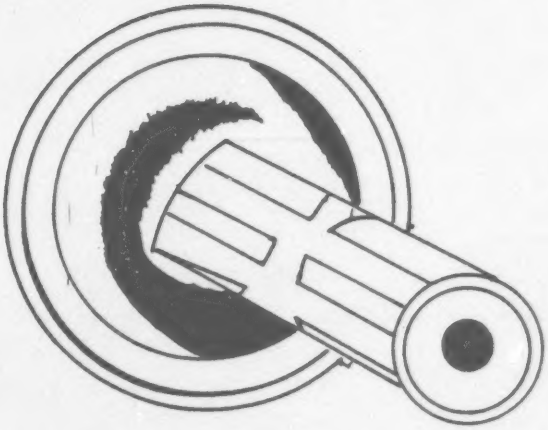
INCORRECT CORRECT

EXTEND DRAW BAR BEYOND PTO SHAFT TO ALLOW PROPER TURNING

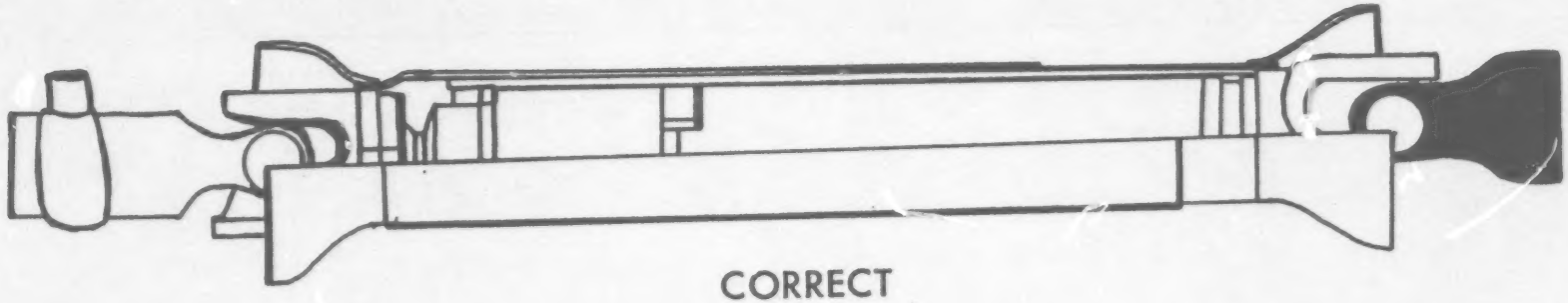
PTO SHAFTS

1000 RPM 21 SPLINE SHAFT

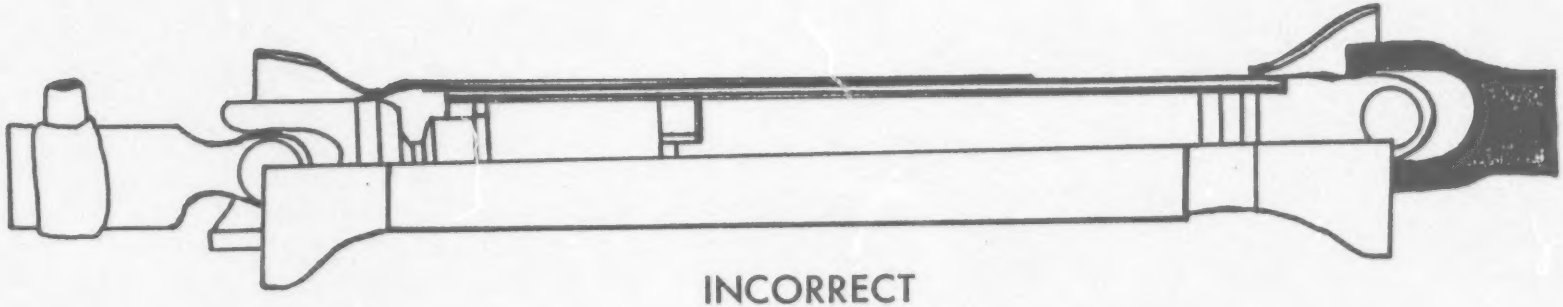




540 RPM 6 SPLINE SHAFT



CORRECT



INCORRECT

U-JOINTS MUST BE FACING SAME DIRECTION

Job IV: Maintaining Tractors and Trucks.

Objectives:

The objectives of this job shall be met at a level predetermined by the instructor. The manner in which they are evaluated shall also be determined by the instructor.

Upon completion of this job, the students shall be able:

1. to perform general maintenance operations.
2. to determine the type of fuel used by a tractor.
3. to properly fill a fuel tank.
4. to properly check and add oil to the crankcase.
5. to change oil and filter.
6. to lubricate machinery.
7. to change a grease gun cartridge.
8. to clean air filters.
9. to check and add coolant.
10. to flush cooling system.
11. to check antifreeze solution with a hydrometer.
12. to check electrolyte solution level.
13. to clean a battery.
14. to determine the grounding cable.
15. to check battery charge with a hydrometer.
16. to properly use a battery charger.
17. to properly hook up a booster battery.
18. to check inflation on tires.
19. to change a tire.

Guide Questions:

1. What are some general maintenance procedures?
2. What are some maintenance procedures involving the fuel system?

3. What are some maintenance procedures involving lubrication?

4. What are some maintenance procedures involving the air intake system?

5. What are some maintenance procedures involving the cooling system?

6. What are some maintenance procedures involving the battery?

7. What are some maintenance procedures involving tires?

References:

Basic Vocational Agriculture III. Vocational Instructional Services, Texas A & M University, College Station, Texas.

Basic Vocational Agriculture IV. Vocational Instructional Services, Texas A & M University, College Station, Texas.

Hathoway, Louis. Fundamentals of Machine Operation - Preventive Maintenance. John Deere Service Publications, Deere & Company, Moline, Illinois, 1973.

Silletto, Thomas A. and Dale O. Hull. Safe Operation of Agricultural Equipment - Student Manual. St. Paul, Minnesota: Hobar Publications.

Tractor Fuels and Lubricants - Selecting and Storing. American Association for Agricultural Engineering and Vocational Agriculture, Agricultural Engineering Center, Athens, Georgia, January 1970.

Tractor Operation and Daily Care. American Association for Vocational Instructional Material, Athens, Georgia, 1970.

Interest Approach:

Ask the students what would happen if, supposing they were on the basketball team ready to play an important game, the basketballs were all flat, the rims bent or missing, their shoelaces broken or missing, the referees had no whistles, the water jug was empty, etc. Point out the importance of keeping things properly maintained and relate it to tractor and machinery maintenance.

Key Facts:

I. General Maintenance.

A. Keep the machine clean.

1. Clean mud, trash, dust, oil, and grease from tractor.

a. Runs more efficiently.
b. Prevents rusting.

2. Clean windows of cab for better vision.

B. Make sure all nuts, bolts, shields, etc. are tight.

1. Vibration could shake loose.

2. Piece could get into moving parts and cause damage.

C. Make sure all belts and chains are adjusted properly.

D. Make a daily inspection of the tractor.

E. Keep accurate maintenance records.

1. Tell when and what kind of maintenance practice was performed.

2. Keep records in a handy place.

F. Don't abuse the tractor.

1. Use it only for what it was intended.

2. Run at proper speeds, don't overload.

G. Be thoroughly familiar with the operator's manual.

II. Fuel System.

A. Determining type of fuel to use.

1. Gasoline engine. (Transparency 1)

a. Distributor.
b. Spark plugs.
c. Spark plug wires.
d. Coil.
e. Carburetor.

2. Diesel engine. (Transparency 2)

a. Fuel injector pump.
b. High-pressure fuel lines.

B. Filling the tank.

1. Should be filled after use.

a. Allows water and sediment to settle out.
b. Decreases amount of condensation with less air in tank.

2. Should allow 24 hours for storage tank to settle after being filled by supplier.

3. Procedure.

a. Check for fire hazards, make sure engine is cool.
b. Wipe dust from nozzle, top of fuel cap and area around tank opening.
c. Fill tank ALMOST full.

1. Avoids overflow.
2. Allows room for expansion.

d. Replace cap tightly.
e. Drain water from fuel tank next morning before starting tractor.

C. Fuel Storage.

1. Tank should tip so that sediments settle away from spout. (Transparency 3)

2. Above ground tanks should be drained and cleaned twice a year.

3. Underground tanks should have water and sediment pumped out once a year.

4. Shading above ground tanks will help prevent evaporation.

III. Lubrication Systems.

A. Checking crankcase oil level. (Transparency 4)

1. Should be checked daily, all engines use some oil.

2. Do not check while engine is running. Allow several minutes for the oil to drain down to the oil pan before checking if the engine has been running.

3. Make sure tractor is on level ground.

4. Procedure.

a. Clean area around dipstick.
b. Remove dipstick and wipe dry with a clean cloth.
c. Insert it fully and then withdraw again.
d. Take reading of oil level.
e. If level is below the ADD mark, add oil.
f. Use the proper grade and type.
g. Use a clean container.
h. Oil may be added at dipstick or some other fill hole depending on the tractor.
i. Do NOT overfill.

B. Changing oil. (Transparency 5)

1. Check operator's manual for frequency.

2. Engine should have been started and warmed up.

a. Warm oil will drain faster.
b. Sediments less likely to remain in oil pan.

3. Procedure.

a. Shut off engine.
b. Place collecting container under drain plug.
c. Remove drain plug.
d. If plug is magnetic, remove metal particles from it.
e. Allow oil to drain completely.
f. Wipe dirt from filter and surrounding area.
g. Remove old filter and install new one.

1. Disposable filter.

a. Discard old filter.
b. Apply light coat of oil to gasket or sealing ring.
c. Screw the filter on until the seal contacts the base and turn no more than 1/2 a turn more. Overtightening will distort the filter. Check filter instructions for exact procedure.

2. Disposable element. (Transparency 6)

a. Remove and discard element and gasket.
b. Clean filter bowl and base with solvent.
c. Insert new filter cartridge element.
d. Install new gasket and apply a light coat of oil.
e. Screw on filter bowl. Do not overtighten.
f. Replace drain plug.
g. Fill crankcase with new oil. Use amount and type of oil recommended by the manufacturer.
h. Start the engine and let it run for a few minutes.
i. Check for oil leaks around drain plug and filter. Also check oil pressure gauge.
j. After shutting off engine, allow to sit for a few minutes, then check the oil level.
k. Save used oil to be collected by the dealer and recycled.

C. Greasing.

1. Multipurpose grease most commonly used for all applications.

2. Frequency.

a. Check operator's manual.
b. Look for symbol of grease gun near fitting. (Transparency 7)

3. Procedure for greasing.

a. Wipe dirt and grease from fitting.
b. Hold grease gun directly in line with fitting and push nozzle onto it.
c. Pump slowly. Too much lubricant or pressure may be harmful to bearing if a seal should get broken.

d. Remove grease gun by turning.

4. In cold weather, grease after equipment has been operated.

5. Procedure for changing grease cartridges.

a. Pull T-handle back and lock.
b. Unscrew pump end.
c. Remove empty cartridge.
d. Insert full cartridge.
e. Remove cap from cartridge.
f. Screw on pump end.
g. Release T-handle.

IV. Air Filters.

A. Check operator's manual for frequency of servicing.

B. Oil-bath type.

1. Check only while engine is shut off.

2. Remove oil cup and inspect to see if it needs changing.

a. Accumulation of dirt.
b. Oil appears thick.

3. Procedure for servicing. (Transparency 8)

a. Discard old oil.
b. Clean oil cup with solvent.
c. Remove foreign material from screen.
d. Refill cup with proper amount and type of oil.

1. Consult operator's manual.
2. Too much or too thin oil may get sucked into engine.
3. Too thick or not enough oil will not do a proper job filtering.

e. Replace oil cup.

C. Dry type.

1. Check only while engine is shut off.

2. If equipped with a rubber valve, or dust unloader, open to release dust.

3. Wipe dust from cover and exposed end of air cleaner.

4. Remove filter and inspect for holes and damaged gasket.

5. If none found, filter does not have to be replaced but should be cleaned before re-installing.

6. Cleaning procedure. (Transparency 9)

   a. Tap and shake element to loosen dirt.
   b. May use low pressure (200 KPa or 30 psi) air to clean, blowing from inside out.
   c. Wash the element with water and detergent.
   d. Rinse with clean water.
   e. Allow 24 hours to dry.
   f. Re-insert element.

D. Pre-cleaner. (Transparency 10)

   1. Removes larger particles.

   2. Should be inspected and emptied frequently.

E. Inspect all intake hoses, pipes and connections daily.

   1. Engine could be ruined by having a hose off for only a few hours.

   2. Engine could be ruined by only a pinhole leak left for a season.

V. Cooling System.

A. Check coolant level daily.

   1. Never open cap when hot. Check cold or allow to cool. (Transparency 11)

   2. Level should be about 5 cm. (2 in.) from radiator neck. (Transparency 12)

   3. Add only clean soft water, or antifreeze.

   4. Add while engine is cold if possible. If you must add when warm, leave engine idling and add slowly.

B. Check for leaks around hoses and clamps.

C. Remove trash from radiator screen often.

D. Have cap pressure checked if problem recurs.

E. Flushing the system.

   1. Should be done before installing antifreeze.

   2. Drain system and refill with clean water.

   3. Run engine until warm.

   4. Shut off engine and open all drain plugs.

F. Cleaning the system

1. Similar procedure used.

2. Acid base cleaner used for 2-3 hours at operating temperature.

3. Lye solution follows to flush system.

4. Rinsed with clean water.

G. Checking antifreeze solutions. (Transparency 13)

1. Use a hydrometer to check specific gravity.

2. Remove cap, insert hydrometer, draw coolant into barrel and take reading.

3. If antifreeze is needed, drain some coolant and add antifreeze. Do not mix types (alcohol and ethylene glycol).

VI. Batteries.

A. Checking electrolyte.

1. Should be checked every 50 hours.

2. Remove vent cap from each cell and check level. Electrolyte should be to bottom of the filler neck, so top of plates are covered. (Transparency 14)

3. Should use distilled water if level is low. Do NOT use hard water. (Transparency 15)

4. Do NOT fill to top of filler neck. When battery is charging it will overflow.

5. If adding water in cold weather, charge battery afterwards to mix water with electrolyte to prevent freezing.

6. Some batteries are sealed and do not need checking.

B. Cleaning. (Transparency 16)

1. Battery should be cleaned every 250 hours.

2. Remove ground cable.

a. Loosen bolt on clamp.
b. Spread jaws of clamp.
c. Use a clamp puller if available.

3. Remove other cable in same manner.

4. Wipe off clamps and dip in baking soda water solution to neutralize the acid.

5. Remove corrosion from clamp with wire brush or sand paper.

6. Wipe the clamps clean with a dry cloth.

7. Remove corrosion from battery posts in same manner.

8. Remove dirt and corrosion from top of battery with a stiff brush.

9. Apply baking soda water solution to top of battery and posts. Add solution until foaming stops. Do NOT let any solution enter the vent caps. Make sure they are securely tightened.

10. Rinse residue from battery with clean water. Again do not let anything enter the vent caps.

11. Dry top of battery with a clean cloth.

12. Attach cables in reverse order, ground cable last. Do not pound on clamps as battery post may break.

13. Apply light grease or petroleum jelly to top of connection.

C. Determining ground cable.

1. Ground cable is normally the negative post.

2. Ground cable attaches to the frame or engine block.

3. Other cable goes to starter or switch.

4. Ground cable often not insulated.

D. Checking the charge. (Transparency 17)

1. Hydrometer used to check specific gravity.

2. Remove vent cap.

3. Insert hydrometer and draw electrolyte into barrel.

4. Take reading.

5. Replace cap and rinse hydrometer before proceeding to next cell.

E. Charging.

1. Best to charge at a slow rate for 12 to 24 hours.

2. Remove vent caps.

3. See manufacturer's instructions for operating and attaching charger.

4. If battery is not charged within 48 hours, battery may have to be replaced.

F. Boosting.

1. Make sure both are same voltage. Number of cells indicates voltage.

2. Always attach positive to positive, and negative to frame.

3. Attach ungrounded cables first.

4. Attach cable to ground post of boosting battery.

5. Make the last connection to the frame of the boosted vehicle away from the battery. Should be a few sparks if good connection is made. Too many sparks may mean cables are reversed.

G. After engine is started, remove cables in reverse order.

VII. Tires.

A. Checking inflation.

1. Check tires when cold.

2. Never "bleed" air from warm tires.

3. Hold gauge firmly against valve stem. (Transparency 18)

4. Add or release air to achieve proper pressure.

5. Visual inspection. (Transparency 19)

a. Underinflated.

1. Tire sits extra low. (Normal for radial tires)

2. Excess wear on sides of tire.

3. Cracking of sidewalls.

b. Overinflated.

1. Edges of tread lifted off ground.

2. Excess wear on center of tread.

6. Both overinflated and underinflated reduce traction, cause excess wear, and make driving difficult. Underinflation is more damaging.

7. Tires with liquid ballast require special method of testing. Check the operator's manual.

B. Changing.

1. Put in park, lock brakes, and block tires to prevent rolling.

2. Loosen lug nuts.

3. Position jack securely and raise until tire is off the ground.

4. Remove lug nuts.

5. Remove wheel.

6. Attach spare tire and lug nuts. Screw lug nuts until finger tight.

7. Lower and remove jack.

8. Tighten lug nuts.

Student Learning Activities:

1. Have students make a general inspection for dirt and dust, loose nuts, bolts and shields, loose or worn belts and chains, worn or loose radiator or battery connections, etc.

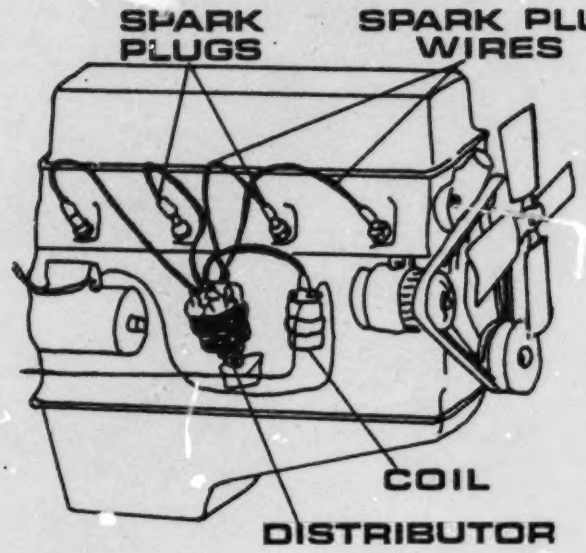
2. Have students inspect tractors to determine type of fuel used.

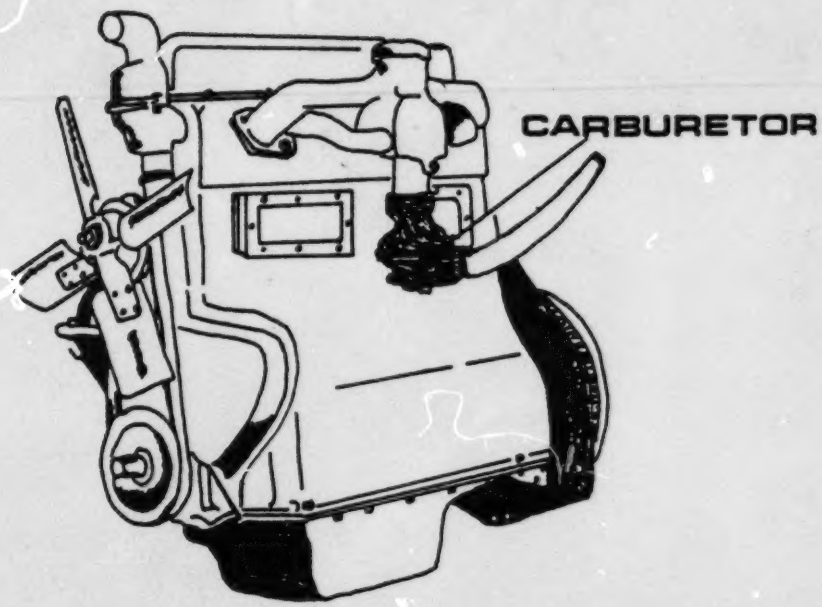
3. Have students perform maintenance procedures: fueling, checking and changing oil, greasing, cleaning air filters, checking coolant level and antifreeze solution, flush cooling system, check, clean and charge batteries, and check tire pressure.

4. Have students hook up booster cables. Be sure to have them first locate the grounding cable.

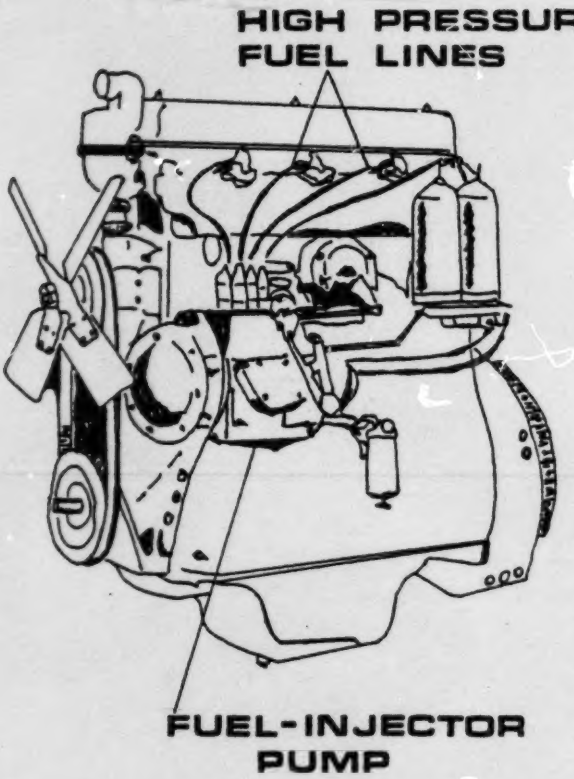
5. Have students change a tire.

6. Show slide set Safe Operation of Agricultural Equipment - Unit 3, available from: Media Library, Agricultural Communications Department, North Dakota State University, Fargo, North Dakota.

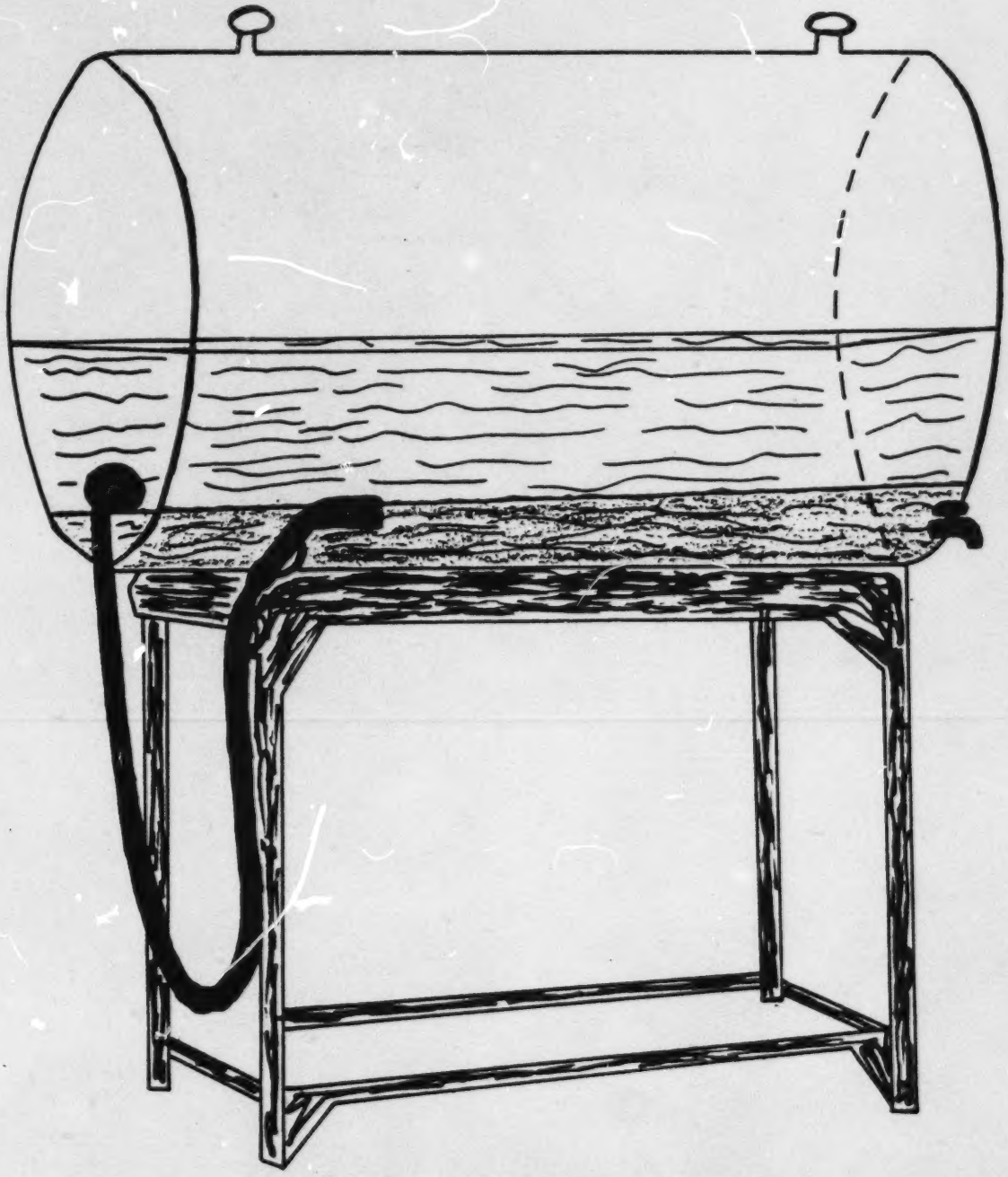




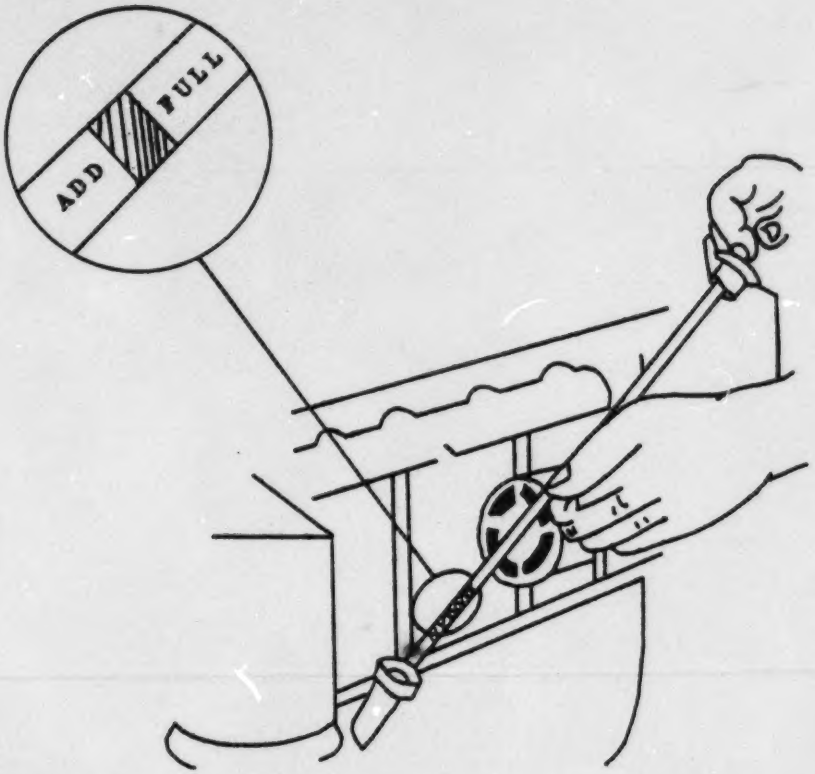
ESSENTIALS OF A GASOLINE ENGINE



ESSENTIALS OF A DIESEL ENGINE



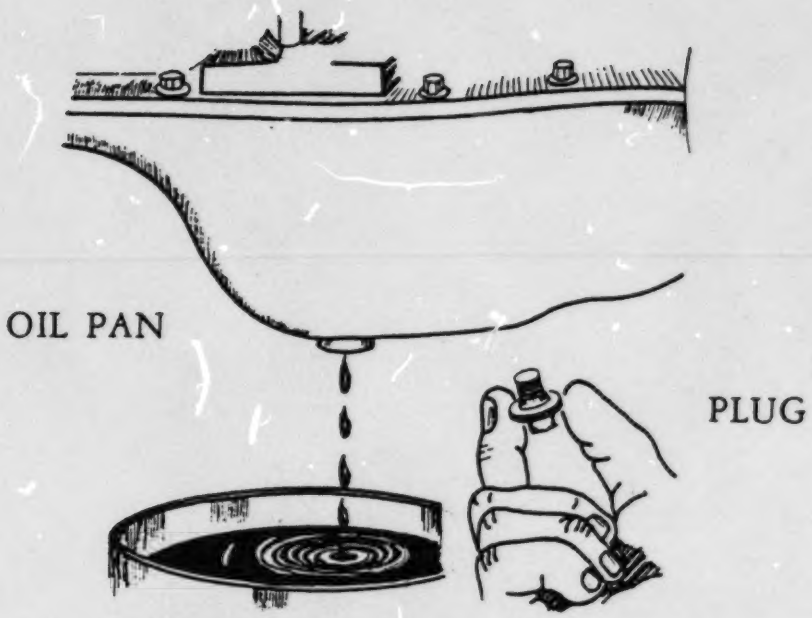
SLANT TANK SO SEDIMENTS SETTLE AWAY FROM SPOUT



CHECKING CRANKCASE

OIL LEVEL

CHANGING OIL

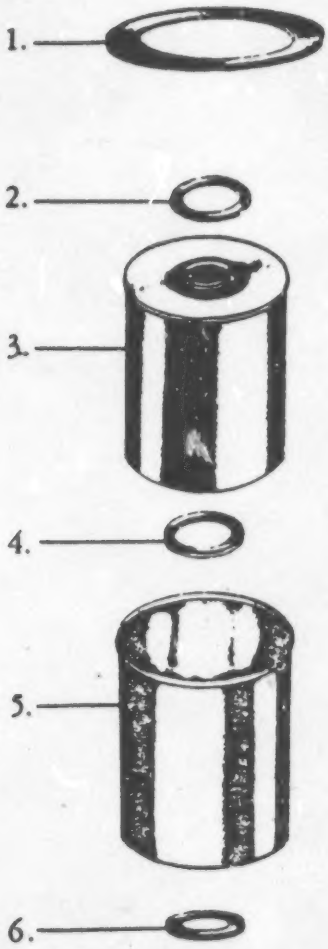


Courtesy of Vocational Instructional Services, Texas A&M University, College Station, Texas

SERVICING OIL FILTER

CLEANING FILTER HOUSING

REPLACING BYPASS ELEMENT



1. HOUSING GASKET
2. GASKET
3. FILTER ELEMENT
4. GASKET
5. FILTER HOUSING
6. GASKET

Courtesy of Vocational Instructional Services, Texas A&M University, College Station, Texas

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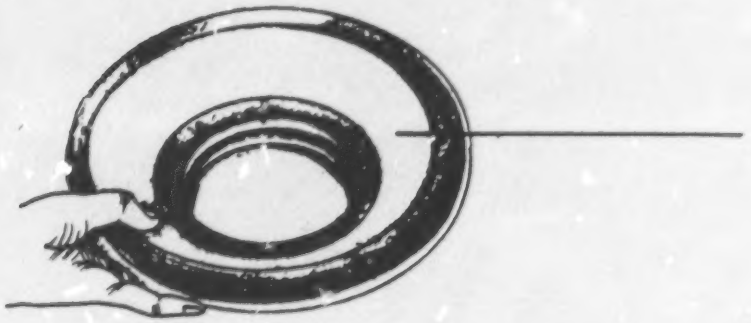
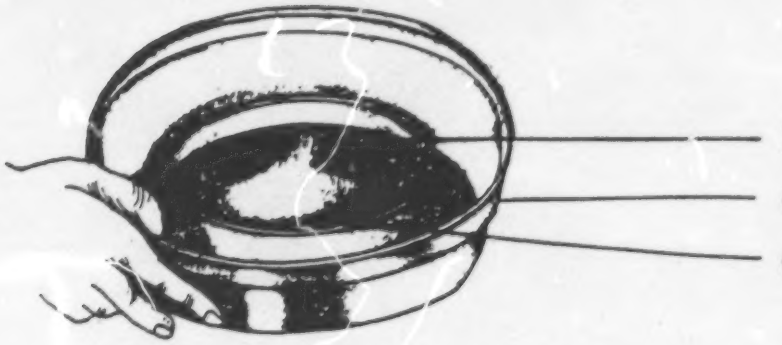
GREASE FREQUENCY SYMBOL

SERVICING OIL-BATH TYPE AIR CLEANER

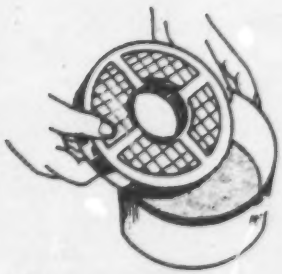
A-9-4
TM 8



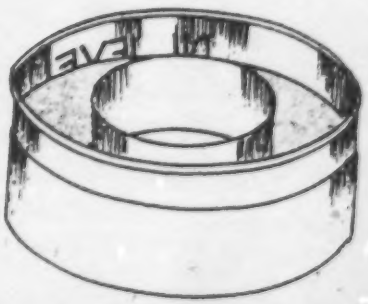


HEAVY DUTY OIL BATH TYPE AIR CLEANER

CLEAN OIL CUP



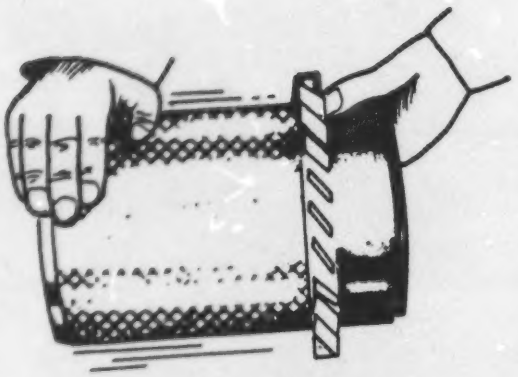
REMOVE FOREIGN MATERIAL FROM SCREEN



REFILL OIL CUP TO OIL LINE

Courtesy of Vocational Instructional Services, Texas A&M University, College Station, Texas.

CLEANING THE DRY ELEMENT



TAP ELEMENT TO LOOSEN DIRT

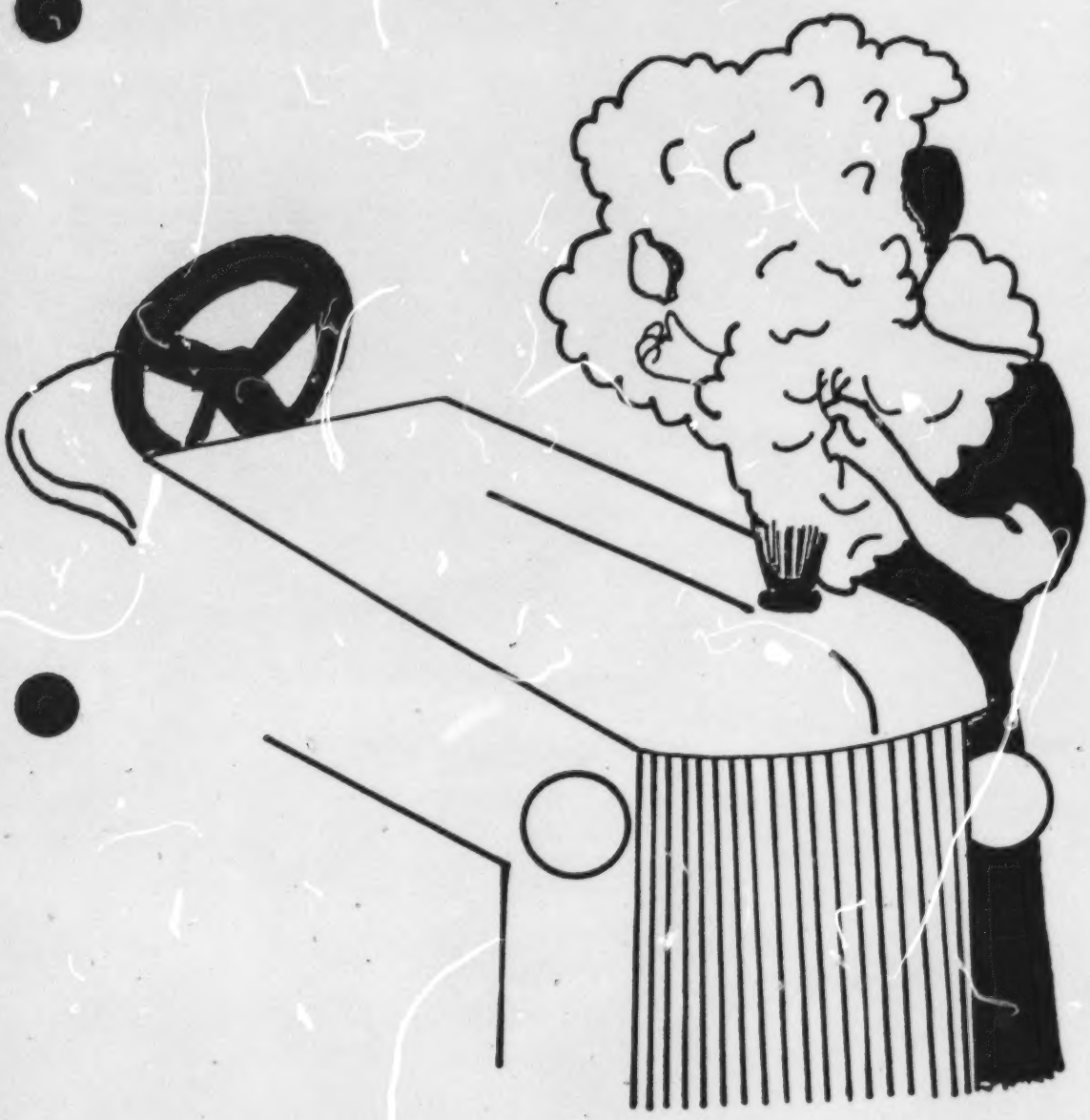
USE AIR TO
REMOVE DIRT

WASH ELEMENT
IN SOAPY WATER

RINSE ELEMENT
WITH CLEAN WATER

Courtesy of Vocational Instructional Services, Texas A&M University, College Station, Texas.

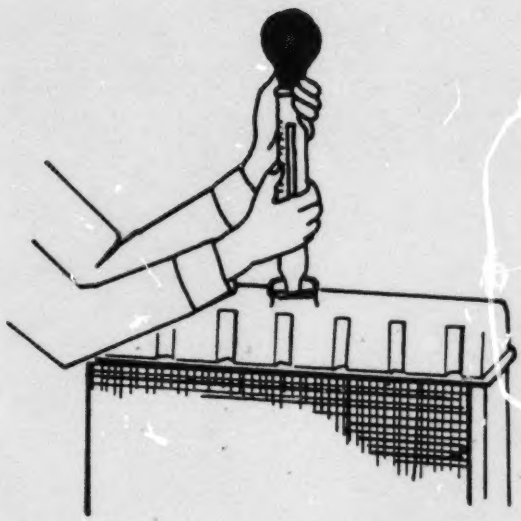
EMPTY PRE-CLEANER FREQUENTLY



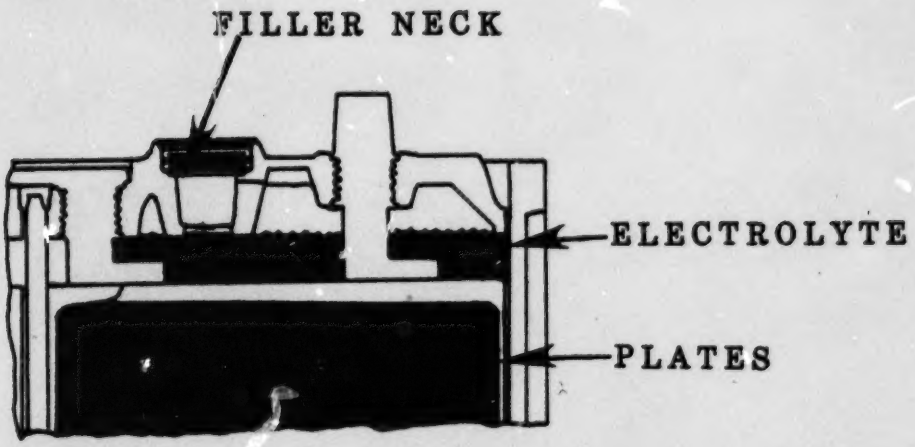
NEVER OPEN CAP WHEN HOT.
CHECK COLD OR ALLOW TO COOL.

DON'T FILL RADIATOR COMPLETELY FULL.

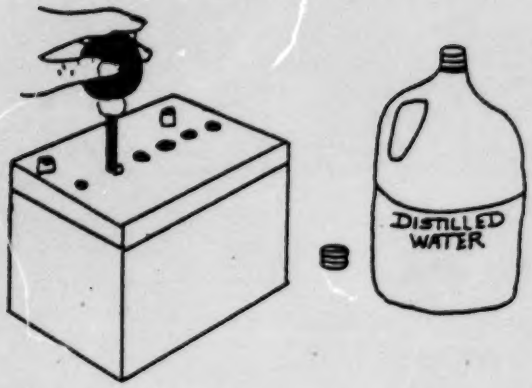
LEAVE ROOM FOR EXPANSION.



USE A HYDROMETER TO CHECK ANTIFREEZE SOLUTION

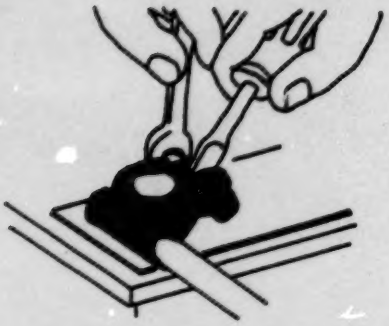


ELECTROLYTE SHOULD COVER PLATES AND COME TO BOTTOM OF FILLER NECK

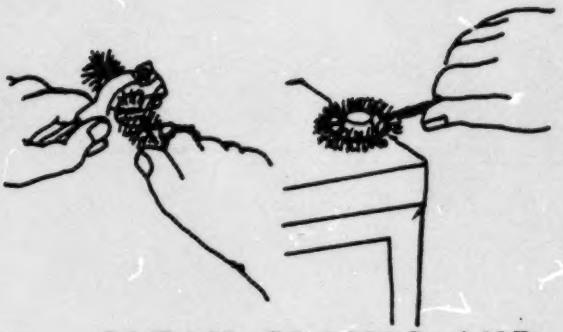


ADD ONLY DISTILLED WATER TO THE BATTERY

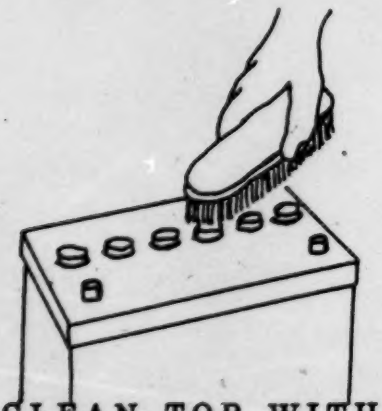
CLEANING A BATTERY



SEPARATE JAWS
BEFORE REMOVING CLAMP

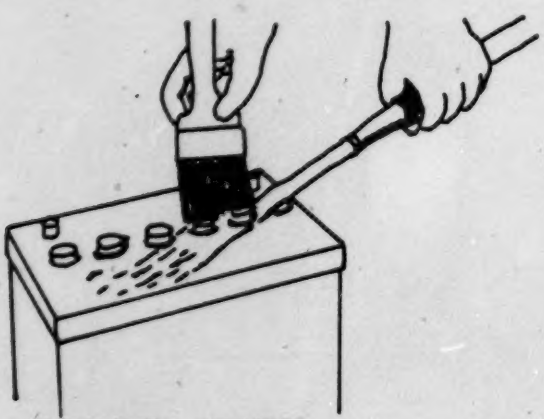


CLEAN CLAMPS AND
POSTS WITH A WIRE BRUSH

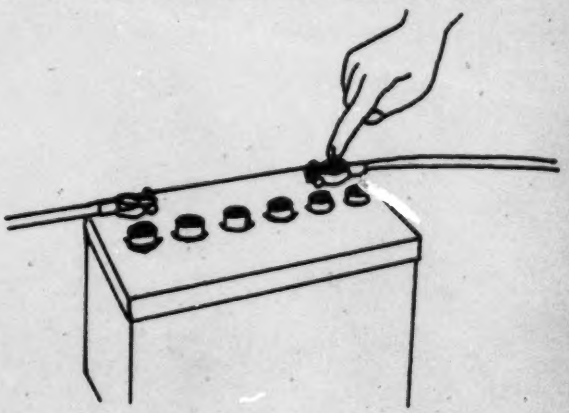


CLEAN TOP WITH
A STIFF BRUSH

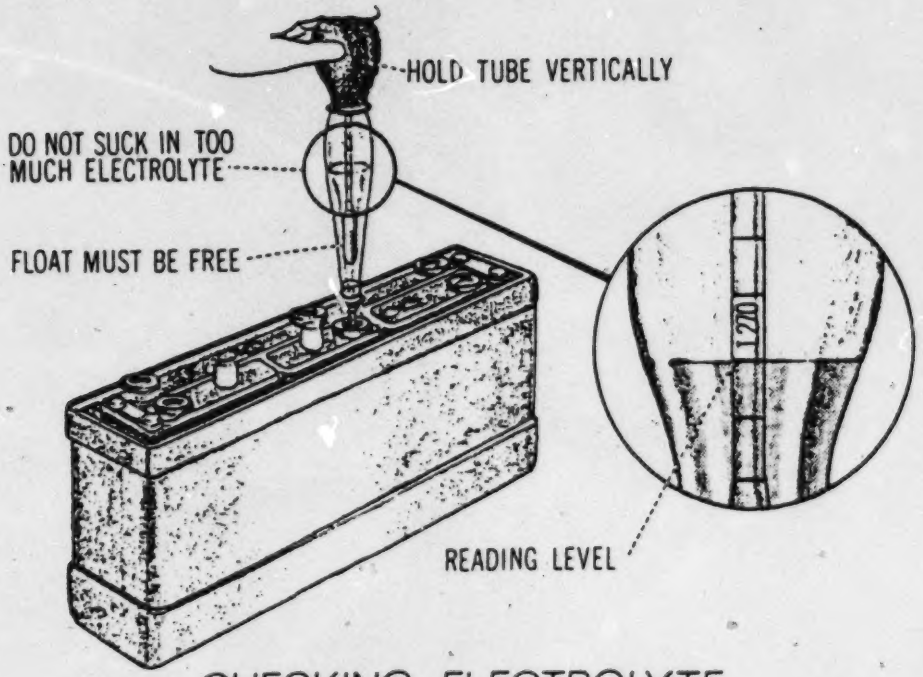
NEUTRALIZE TOP WITH
SODA-WATER SOLUTION



RINSE WITH
CLEAN WATER



APPLY LIGHT GREASE
TO CONNECTION



CHECKING ELECTROLYTE

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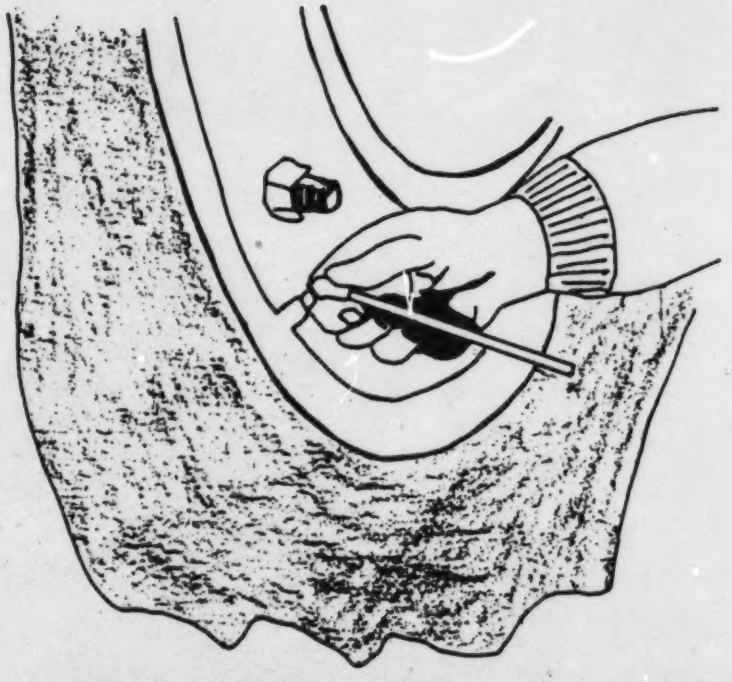

HOLD GAUGE FIRMLY AGAINST VALVE STEM WHEN CHECKING AIR PRESSURE

Courtesy of Vocational Instructional Services, Texas A&M University, College Station, Texas